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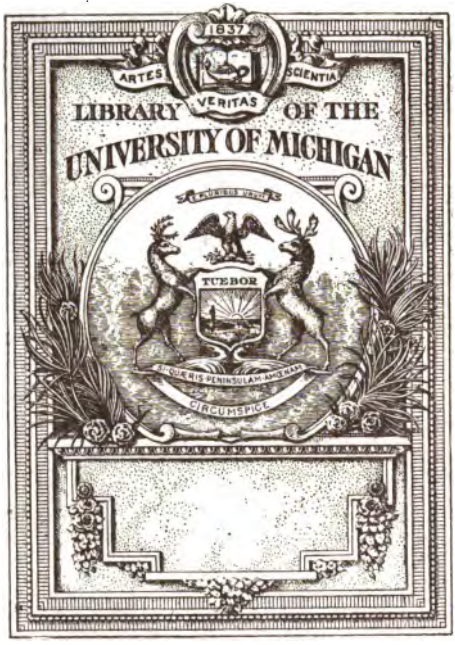
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CLASSES FOR GIFTED CHILDREN

An Experimental Study of Methods of Selection and Instruction

By

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TABLE OF CONTENTS

		Page
Introduction: The Problem		5
CHAPTER		
I.	The Organization of the Special Classes	9
	Selection of the Pupils	10
	The Control Classes	11
	Personal Data of the Selected Pupils	11
II.	Classification of the Mental and Educational Tests	13
III.	The Mental Tests and Their Outcomes	19
	A. Individual Tests	19
	1. The Binet-Simon Test	19
	2. The Four Form-Boards	22
	3. Picture-Arrangement Test	22
	4. Healy-Pintner Picture Completion Test	22
	5. Painted Cube Construction Test	23
	6. The Porteus Maze Tests	23
	7. Pyle Marble-Sorting Test	23
	8. Easy Directions and Hard Directions Tests	24
	9. Easy and Hard Opposites Tests	25
	10. The Analogies Test	25
	B. Group Tests	26
	11. Cancellation	26
	12. Memory ('Lincoln' and 'Marble Statue')	27
	13. Memory ('Dutch Homestead')	28
	14. Manuel Perceptual Learning Test	29
	15. Letter Substitution Test (Thurstone)	29
	16. Digit-Symbol Substitution Test	30
	17. Character-Traits Directions Test	31
	18. Word Building, I and II (Whipple)	32
	19. Terman and Childs Completion Test	32
	20. Terman Completion Test	33
	21. Trabue Language Scales, B and C	33
	22. Trabue Language Scales, J and K	34
	23. Completion of Number Series (Thurstone)	34
	24. Completion of Number Series (Coy)	35
	25. Original Analogies	36
	26. Equivalent Proverb	37
	27. Reasoning Tests, IV, V and VI (Bonser)	38
	28. Inference Test (Thurstone)	39
	29. Reasoning Test (Thurstone)	40
	30. Hand Test (Thurstone)	40
	31. Spatial Relations Test A (Thurstone)	41
	32. Punched Holes Test (Thurstone)	41
	33. Flag Test (Thurstone)	42
	34. Steacy Drawing Construction Test, 1-40	44
	35. Steacy Drawing Construction Test, 41-100	45
IV.	The Educational Tests and their Outcomes	47
	36. Buckingham Spelling Test	48
	37. Ayres Spelling Test	48
	38. Handwriting	48
	39. Drawing a Church and a Snowball Fight	49
	40. Drawing a Horse	49
	41. Drawing a Toy Wagon	50

345803

42. Esthetic Appreciation Test..... 51
43. Constant Increment Test..... 52
44. Error-Checking Test (Thurstone)..... 52
45. Practice Test in Multiplication..... 53
46. Courtis Arithmetic Tests Series A and B. 54
47. Woody Arithmetic Tests Series A..... 56
48. Woody-McCall Mixed Fundamentals..... 57
49. Reasoning Tests, I and II (Bonser)..... 58
50. Thorndike Reading Scale A. 59
51. N. Y. Ventilation Commission Vocabulary 60
52. Thorndike Reading Scale Alpha..... 60
53. Thorndike Scale Alpha 2, Part II..... 61
54. Punctuation Test 62
55. Winch Composition Test..... 63

V. Individual Differences in Mentality in Special Group.. 65
A. Summarizing for Each Pupil the Test Outcomes 69
1. The Pupil's Record Card..... 69
2. The Percentile Tables..... 69
3. Classification of the Tests..... 70
4. 'Ability Profiles' 70
5. Report for Parents and Teachers..... 73
B. The Ambitions and Ideals of Individual Pupils 76
C. Individual Differences in Non-Intellectual Traits 78

VI. Relation of the Test Results of Pupils in the Special Group to other Indexes of Intelligence.. 80
A. The Median Test Percentile..... 80
B. The Teacher's Estimates of Intelligence..... 81
C. Correlations of Various Criteria of Intelligence. 82
D. Relation of Test Results to School Achievement. 83

VII. Individual Differences in Mentality in Control Group.. 94
A. 'Gifted' Children in the Control Group..... 94
B. 'Average' and 'Dull' Children in Control Group 97

VIII. Choice of Tests for Selecting Gifted Pupils.....100
A. Methods of Making the Choice.....100
B. Recommended Program of Tests.....106
C. An Illustrative Case.....107

IX. Choice of Tests for Differentiating Abilities Within a Group of Gifted Pupils.....110

X. The Adaptation of Teaching Methods to Gifted Children 113
A. Recommendations, Pertinent to any Classroom..115
B. Recommendations Pertaining Specifically to Classrooms for Gifted Children.....118

XI. An Analytical Study of Talent in Drawing.....126
A. General Plan 126
B. Previous Studies 127
C. The Tests Employed.....127
D. Summary of Experimental and Personal Data..133
E. Inferences Concerning the Psychophysical Characteristics of Talented in Drawing.....135
F. Desirable Program for Testing Drawing Ability.139
G. Annotated Bibliography of References Consulted in this Study of Talent in Drawing....142

XII. Partial Bibliography on Gifted Children and Education.148

INTRODUCTION

The Problem

The rise of every system of universal public education has compelled the development of a system of grading and grouping whereby relatively large numbers of children of approximately the same pedagogical status may be handled in a single class: some such arrangement would appear to be inevitable if economy of time and money is to be secured. No one conversant with the situation, however, will contend that the pupils of a given grade in our ordinary public-school classes are, *ipso facto,* alike or even very similar to one another in range of information, in susceptibility to training, in general intelligence. On the contrary, every one will admit that a considerable inequality exists in these respects, so that, while we gain by our system of grade grouping in one way, we lose by the same system in another way. Evidently, if a given system were large enough so that it would be possible, let us say, to subdivide the pupils of the fourth grade into ten classes, we might gain the advantages of grouping and also gain the advantages of homogeneity within the groups by sorting the pupils into ten groups in such a way that each group should comprise pupils of closely similar ability.

Now, it is clear that the greater the diversity of capacity within a given group, the less readily may instruction and training proceed, for a pace can not be found that will prove at once suitable for the dull, the average and the bright pupil. The fact that the dull child in especial fails to profit by instruction adjusted to the mental pace of the average has been obvious to all observers and

for that reason the idea that special classes ought to be formed for the instruction of extra-dull pupils has been received with almost no opposition. Experience in many cities has shown the value of the idea, and it has turned out that the advantages have accrued almost as much to the pupils of the regular as to those of the special classes. The evolution of this principle has given rise to an extensive literature and to a fairly well-developed pedagogy of the subnormal child: into details it is unnecessary to go.

Our problem concerns the children at the other end of the intellectual scale. Is it not probable that bright children as well as dull children fail to profit to the utmost from instruction and training adjusted to the mental pace of the average? Will not the segregation of bright children into special classes be as profitable as the segregation of dull children proved to be? Granted an affirmative answer, there must be raised numerous more specific questions: At what grade ought such a selection to be made? By what method ought pupils to be selected for the special class? How many ought to be placed in a given class? Does the teacher need special qualifications? Ought the course of study to continue the same? Or ought it to be enlarged by supplementary work? Or ought the course of study to be abolished entirely? Ought the pupils to do more or to do less home work? Ought the methods of instruction—the use of illustration, of induction, of practise drills—to be altered? Ought the pupils to be encouraged to participate more actively in class discussions or ought these tendencies to be repressed in favor of rigorous drill and the development of a high degree of precision and speed? What should be done to detect and to foster

specialized ability, such as talent in drawing, music, design, dramatic expression, mechanical pursuits, invention and the like?

Every one of these questions would well repay careful investigation, but the one obvious point of attack at the outset is *method of selection,* for unless pupils can be rightly selected, it is of little use to study their reaction to methods of instruction in a special class, however wisely the class might be managed. My own attempts to study this matter of selection were frustrated by various circumstances until in the late summer of 1917 the General Education Board, after several conferences between myself and its representative, Dr. Flexner, appropriated a sum of money to be expended by me during the ensuing academic year at Urbana, Illinois, in the investigation of the general problem of the education of the gifted child, with the understanding that effort should be directed primarily toward answering the question: *what mental tests are most valuable in selecting from ordinary public-school classes bright pupils for training in special classes for gifted children?* This problem was the primary object of the labors of Miss Genevieve Coy, who served as my private research assistant from September, 1916, to September, 1917, and without whose expert and industrious services this account could not have been written. I have presented here a condensed account of the results of her investigation; some of the more detailed results may, I hope, be published elsewhere.

In a similar manner I have presented here the substance of the investigations conducted by Dr. T. S. Henry and Dr. H. T. Manuel, both of which may perhaps be published elsewhere in detailed form. Dr. Henry, in

the preparation of his doctorate thesis at the University of Illinois, gave attention to the classroom work of the class of selected children and aimed to discover what changes in methods of instruction and in organization of subject matter would be advantageous for these children. Dr. Manuel, in his thesis work, gave attention to the study of specialized ability in drawing.

All these investigations were greatly facilitated by the coöperation of the Board of Education of Urbana and of the Superintendent of Schools, Mr. A. P. Johnson. A plan was devised whereby a portion of the appropriation of the General Education Board was expended in part-payment of the services of the teacher to whom was assigned charge of the class of selected pupils. The Board of Education supplied the necessary room and equipment in the Leal elementary school and paid the remainder of the teacher's salary. This plan created a sort of experimental room in which I was permitted to work with reasonable freedom in the matter of trying various mental tests upon the pupils, while the final jurisdiction in matters of school organization remained with the Urbana school authorities. I was also permitted to do a considerable amount of check testing in other rooms of the Leal School and thus to obtain control data of quite vital importance to our interpretations.

Chapter I

THE ORGANIZATION OF THE SPECIAL CLASSES

The Leal School in which the Special Room was located is the largest elementary school in the city of Urbana. It enrolls some 400 pupils in 12 rooms limited to the first six grades. The teaching force consists of eleven teachers and a principal, practically all of whose time, however, is spent in teaching. The district served by the school is a rather large one and includes most of the University residence district, as well as a representative portion of the residence district of the city itself.

The Room and the Building. The physical condition of the room was not better than the average. It was furnished with the ordinary school desks, had no more furniture nor pictures than the other rooms in the building and was no better equipped than were they with books, maps, globes, or similar apparatus. The only changes made in the room were to remove completely the Venetian blinds at the north and west windows, to repaint the walls and ceilings in light buff in place of the dingy tones that had prevailed, and to resurface the blackboards in order to remove the gloss. The building is not modern in type and can not be said to be above the average of school buildings in towns of this size.

The Teacher. The teacher in charge of the room was chosen by the city superintendent. It was her first year in the Urbana school system. Her school preparation was above that of the average grade teacher, for she was a graduate of one of the best normal schools in one of our western states and also a graduate of the State University there. Her previous teaching experience includ-

ed practice teaching at the normal school and three years of experience in teaching in the middle and upper elementary grades. She must be ranked high in academic preparation, in sincerity, and in integrity of purpose but low in resourcefulness and initiative. Her work with the children in the special room was observed and her efficiency rated by three well-known schoolmen, and all agreed in rating her as "average" or "slightly above average." In our own opinion, her lack of animation and enthusiasm was sufficient more than to counterbalance her superior training and academic preparation, and on this account we believe that with respect to the teacher the conditions in this room were, again, just about average. The only really distinctive factor in our experiment, then, consisted in the superior intelligence of the children who made up the enrollment of the room.

Selection of the Pupils. It had been expected that the pupils for the special room would be selected by myself on the basis of mental ability, but actually the selection was made by the principal of the school in consultation with the teachers, and primarily upon the basis of the record made by the pupils in their school work, with due reference also to their health, their industry and their application. As a matter of fact, the change in the plan of selecting the pupils was a fortunate one—fortunate, because, as will be shown later, several pupils were selected who should not have been sent to this room, while others who should have been sent were not selected, and these mistakes were discovered as soon as mental tests were used, so that the superiority of the tests to the ordinary classroom records of the public school for the purpose of classification by ability was thus made clearly manifest. Fifteen pupils were selected from those in

the Leal School who were ready to enter the 5th grade and an equal number from those who were ready to enter the 6th grade. The room, then, consisted of 30 pupils—15 in the 5th grade and 15 in the 6th grade—who represented practically the top 20 per cent. of the enrollment in each of these two grades in the entire school.*

The Control Classes. In addition to the 30 pupils just mentioned, there were in the Leal School 57 5th-grade and 62 6th-grade pupils. These were enrolled in three different rooms and served as a Control Group for the purpose of checking the results of the various educational and psychological tests which were applied to the selected pupils. These three rooms are referred to in this report as Room 6G, Room 5Y, and Room 5-6F. Room 6G contained 40 6th-grade pupils; Room 5Y contained 48 5th-grade pupils; Room 5-6F contained 19 5th and 19 6th-grade pupils.

Personal Data of the Selected Pupils. In the Special Fifth there were five boys and ten girls; in the Special Sixth, eight boys and seven girls. The median age of the Special Fifth on December 31, 1916, was 10 years, 6 months, as against a median age on the same date for the other 57 5th-grade pupils in the building of 10 years, 8 months; that is, the experimental group ranged 2 months younger. For the Special Sixth on the same date the median age was 11 years, 7 months and 12 days, as against 12 years for the 62 6th-grade pupils in other rooms; that is, the experimental group ranged 4.6 months younger.

A classification was made of the occupations of the fathers of the children in all the fifth and sixth grades.

*In March, 1916, two pupils were transferred from the Control to the Special Group and one of the Special Group left the city.

It was found that children from homes representing the so-called 'learned professions' were somewhat more likely to attain high rank in school as measured by the ordinary methods. Thus, children from faculty homes furnished somewhat more than their share of the selected group; and if to these are added children from homes representing the other professions, we find that these made up a few more than one-fifth of the Total Group of 5th and 6th-grade children, but at least one-third of the Special Group.

Previous School Progress. The school progress of most of the selected children had been entirely normal prior to their enrollment in the experimental room. Most of them had begun school at six years of age or thereabouts and had made one school grade each year since then. Only one case of repeating a grade was reported, namely, a child who had spent two years in the first grade. Attention should be called to the fact that in only four or five cases had the school made any provision whereby progress more rapid than that of the average child had been possible for these exceptional children.

Chapter II

CLASSIFICATION OF THE MENTAL AND EDUCATIONAL TESTS

The two classes forming the Special Group were organized by the school officials, as has just been said, without the use of any psychological or educational tests other than those ordinarily used, like recitations and examinations. We therefore arranged our experimental work upon the assumption that the pupils of the Special Group, as a group, would probably be found superior mentally to those remaining in the Control Group, but that some of the Special Group might possibly have been wrongly placed there, while some of the Control Group might possibly have been wrongly left out of the Special Group. Our plan was to observe carefully the classroom work of every pupil in the Special Group and also to apply to each pupil a quite extensive series of both mental and educational tests in order to see to what extent the actual performance in the classroom checked with the results of each test. Our plan was also to apply as many as possible of the same tests to pupils in the Control Group in order to determine whether the pupils of the Special Group who in their classroom work most distinctly surpassed their mates in the Control Group would also be found to surpass them in the mental and educational tests, and if so, in which of the tests the correspondence between school achievement and test achievement was of the highest degree. If, as we hoped, certain tests revealed a high correspondence of this sort, then these tests would possess a high predictive or diagnostic value; that is, they could be employed as an administrative device for selecting pupils for special in-

struction in classes for the gifted, and possibly their value in this respect might be distinctly superior (as, indeed, it proved to be) to the value of the teachers' marks and estimates.

It will be understood, then, that our procedure was empirical. We drew up at the outset a lengthy list of tests and fired them, if the comparison may be permitted, like a charge of buckshot, to see which ones hit the mark. As the work continued, the program was altered from time to time; certain projected tests were dropped because they seemed certain to be useless for our purposes or certain to prove mere duplicates of others that had been employed; other tests were added to explore new aspects of the field that were revealed in the course of the investigation. I have no doubt that psychologists and schoolmen will wonder why some of the tests were included and why others were not included. The answer can only be that out of the multitude that were available, some sort of choice had to be made and this choice simply represents the best judgment of the experimenters under the conditions that prevailed.*

In the chapters that follow, the tests that we used have been grouped for convenience as 'mental' tests and 'educational' tests. This distinction is in some cases rather arbitrarily made. Naturally, most mental tests imply the existence in the examinee of more or less educational training, while many so-called 'educational' tests turn out to measure general mental ability, or general intelligence, quite as much as proficiency in the educational field they aim to test. Thus, investigators might

*In the *Seventeenth Yearbook of the National Society for the Study of Education*, Chapter VII, W. S. Monroe lists 84 standardized educational tests for use in elementary grades, 17 for use in arithmetic, 17 for use in language, etc. It is hardly necessary to say that it was out of the question to do more than select a few samples from this wealth of material.

differ as to whether the Trabue language scales, the vocabulary tests and the Winch test are mental tests or educational tests, whereas tests of spelling, drawing, arithmetic and punctuation would generally be regarded as educational tests, and equivalent proverbs, analogies and the Binet tests would generally be regarded as mental tests.

In the present chapter, however, the tests are classified according to the manner of application as 'individual' or as 'group' tests. This classification has considerable administrative significance. In point of economy of time, for instance, group tests have a decided practical advantage, whereas in point of precise analysis of mentality, individual tests have a decided advantage.

Since the order of presentation of tests may have some effect upon their outcome, the tests in this chapter have been listed also in the order of their use (with the Special Group).

As many as was feasible of the tests were given also to the other pupils of the fifth and sixth grades that we have referred to as the Control Classes, or Control Group. For various reasons the tests were applied to the Control Group only after they had been tried with the Special Group, usually one or two months after. Note that on this account the Control Group gained a slight additional advantage in maturity (its members, as has already been said, averaged older than those of the Special Group).

In the list that follows, tests to which an asterisk is prefixed were given to both the Special and the Control Group, except that those thus starred among the individual tests were not given to the entire Control Group, but merely to the number of pupils in that group indicated in the parenthesis that follows the name of the test.

A. Individual Tests

*Stanford Revision of Binet-Simon (Terman) (20)
*Analogies Test (Whipple's Test 34A, Lists A, B, C) (25)
*Easy Directions Test (Woodworth and Wells) (15)
*Hard Directions Test (Woodworth and Wells) (15)
*Healy Picture Test I (15)
*Healy Picture Test II (15)
*Knox Profile Test (15)
*Knox Diagonal Test (15)
*Picture Arrangement Test (Fraser and Whipple) (14)
*Healy-Pintner Picture Test
*Painted Cube Test (Doll) (7)
*Marble Sorting Test (Pyle) (7)
*Hard Opposites (22)
*Porteus Tests (10)

B. Group Tests

Buckingham Spelling Test
Ayres Spelling Test, List N.
Handwriting
Drawing a Church
Drawing a Snowball Fight
Courtis Arithmetic, Series B, Form 2, Test 1
Courtis Arithmetic, Series B, Form 2, Test 2
Courtis Arithmetic, Series B, Form 2, Tests 3 and 4
*Equivalent Proverbs; Form VI
Courtis Arithmetic, Series A, Form 3, Tests 2, 3, and 5
Courtis Arithmetic, Series A, Form 3, Tests 4, 6, and 7
Courtis Arithmetic, Series A, Form 3, Tests 1, 8
*Thorndike Reading Scale A
Thorndike Scale Alpha
*Trabue Language Scale B
Ayres Spelling Test, List R
*Trabue Language Scale C
*Whipple Word Building Tests
*Logical Memory Test "Lincoln and the Pig" (Whipple's Test 39)
*Logical Memory Test "Marble Statue" (Whipple's Test 39)
Ayres Spelling Test, List U
Winch Composition Test; Orphan, etc. (Whipple's Test 46 D2)
Winch Composition Test; Snowstorm, etc. (Whipple's Test 46 D2)
Original Analogies
Woody Arithmetic Test, Series A, Addition
*Deferred (2 weeks) Memory "Lincoln and the Pig"
Deferred (2 weeks) Memory "Marble Statue"
Woody Arithmetic Test, Series A, Subtraction
Woody Arithmetic Test, Series A, Multiplication
Woody Arithmetic Test, Series A, Division
Thurstone Substitution Test
Digit-Symbol Substitution Test (Whipple's Test 37B)
Poetry Preference Test
*Equivalent Proverbs, Forms I and II
*Bonser Reasoning Tests, III, B; V, A and B
*Bonser Reasoning Tests, V, C and D; and VI
*Bonser Reasoning Tests, III, A

Thurstone Error-Checking Test
Completion Test (Whipple's Test 48, No. 4)
Completion Test (Whipple's Test 48, No. 8)
Thurstone Reasoning Test B
Constant Increment Addition Test
*Thurstone Reasoning Test A
*Thurstone Hand Test
Cancellation of Triangles (Whipple's Test 26A)
Logical Memory Test "Dutch Homestead" (Whipple's Test 39)
Cancellation of Circles (Whipple's Test 26A)
Cancellation of 7's (Whipple's Test 26A)
*Drawing Horse from Memory
*Drawing Toy Wagon from Observation
Cancellation of 4's (Whipple's Test 26A)
Character-Traits Directions Test (Thurstone)
*Woody-McCall Arithmetic, Mixed Fundamentals, Series B I
*Woody-McCall Arithmetic, Mixed Fundamentals, Series B II
*Thurstone Punched Holes Test
*Thurstone Flag Test
*Thurstone Number Completion Test
*Thurstone Spatial Relations Test A
*Bonser Reasoning Tests I and II
Thorndike Scale Alpha 2, Pt. II, Steps 4-9
*Multiplication Practise Test
*Trabue Language Scales J and K
Visual Perceptual Learning (Manuel)
Esthetic Appreciation Test (Thorndike)
*N. Y. Ventilation Commission Vocabulary Test
Easy Opposites, List III
*Completion of Number Series (Coy)
*Punctuation Test
*Steacy Drawing Construction Test, 1-20
*Steacy Drawing Construction Test, 21-40
*Steacy Drawing Construction Test, 41-100

It is worth while saying that in all the testing work the pupils, especially those in the Special Group, displayed an admirable attitude. They were unusually well-disposed toward the testing; most of them enjoyed it greatly, were eager to learn their scores and regarded each opportunity to try a new test as a distinct treat.

The description of these tests in detail—methods of application, directions, scoring and interpretation of data—would be impossible in this account. I aim in the chapters that follow to make the presentation cover these various points for each test, but just as briefly as is consistent with intelligent understanding of the work that was done. The quantitative results in particular

will be limited in the main to the presentation of the minimal, average (or median) and maximal scores for each grade in the Special Room and for the corresponding grades in the Control Classes. Comment on the results will be restricted mainly to the significance of the test for the purpose of selecting pupils for a gifted class. Readers who have no professional interest in the necessarily somewhat technical discussion of these details about the experimental work may prefer to skim quickly over the material in Chapters III and IV and resume the discussion at Chapter V.

Chapter III

THE MENTAL TESTS AND THEIR OUTCOMES

All of the individual tests and about twenty of the group tests may properly be classed as mental tests. These will be described here, individual tests first, then group tests, and in an order such as to bring into juxtaposition tests of similar character, regardless of the order in which they were applied to the pupils.

A. INDIVIDUAL TESTS

1. *The Binet-Simon Test (Stanford Revision).* Because the Binet scale is in such common use and because it is the best single measure we possess of the general mental capacity of elementary-school children, we began our testing of the 30 pupils that had been selected for us by a very thorough application of the Stanford Revision of these tests.

As has been shown, our selected pupils are slightly younger chronologically (2 months in the 5th and 4.6 months in the 6th grade) than the pupils left in the Control Group. In mental age, however, they are distinctly 'older.' The average mental age of the Special Fifth was 12 years, 5.5 months; of the Special Sixth, 13 years. In mental age, then, the Special Sixth is only half a year in advance of the Special Fifth. Thus our selected 5th-grade group is as old mentally as the average 7th-grade pupil; our selected 6th-grade group is as old mentally as the average pupil just beginning the 8th grade.

In terms of intelligence quotient (I.Q.) the Special Fifth ranged from 101.5 to 146, with an average of 119.3;

the Special Sixth ranged from 99.3 to 133.1, with an average of 115.9. The two gifted pupils discovered by our mental tests in the Control Group and transferred in March to the Special Room had mental ages of 16 years, 5 months, and 15 years, 11 months, with I. Q's of 167 and 135, respectively.*

SUMMARY OF RESULTS OF BINET TESTS OF THE SPECIAL GROUP

Grade	*Pupil*	*Chronological Age* Years Months	*Mental Age* Years Months	*Intelligence Quotient*
5	1	10–1	18–11	188.0
5	2	10–0	14–8	146.6
5	3	10–3	11–3	109.7
5	4	11–0	11–2	101.5
5	5	10–7	11–4	107.0
5	6	10–5	13–2	126.4
5	7	10–3	11–10	115.4
5	8	10–3	12–7	122.7
5	9	11–1	12–0	108.2
5	10	9–10	11–7	109.3
5	11	10–3	14–6	141.4
5	12	11–1	13–5	121.0
5	13	10–1	10–3	101.6
5	14	10–3	13–5	130.9
5	15	10–10	11–11	110.0
Average		10–5	12–5.5	119.3

Grade	*Pupil*	*Chronological Age* Years Months	*Mental Age* Years Months	*Intelligence Quotient*
6	16	10–4	13–9	133.1
6	17	12–1	14–9	122.0
6	18	11–7	12–5	107.2
6	19	11–2	13–11	124.6
6	20	11–4	11–9	103.6
6	21	12–3	13–1	107.0
6	22	11–7	12–6	124.6
6	23	9–7	12–9	133.0
6	24	11–7	11–6	99.3
6	25	11–4	12–5	110.0
6	26	10–7	12–7	118.8
6	27	11–4	12–10	113.0
6	28	10–10	12–6	115.3
6	29	11–0	12–2	110.6
6	30	12–1	16–1	133.1
Average		11–8	13–0	115.9
5	Y35†	9–10	16–5	167.0
6	F34†	11–9.5	15–11	135.0

*Fewer than 10 children in a thousand are as good as our pupil with an I. Q. of 135. The highest I. Q. found by Terman was 160, so that we may surmise that our girl with an I. Q. of 167 is probably better than the best child in ten thousand. Note that she would have failed to receive an opportunity to profit by her extraordinary ability had she not been 'discovered' by our tests. The average I. Q. of the Special Sixth, 116, is reached, according to Terman, by the best 10 children in a hundred.

†Transferred to Special Group in March, 1917.

Notice that in our very first mental test several of the pupils judged by the school authorities to be especially competent are not especially competent as judged by the Binet test. The situation may be stated conveniently thus. If the selection of the top 20 per cent. of the school population had given us pupils in the top 20 per cent. of intelligence, all I. Q's should have been 110 and over; actually there were 6 pupils in the Special Fifth and 5 pupils in the Special Sixth that showed I. Q's lower than 110.

To prove that the reverse situation held true, that pupils of really superior intelligence had been mistakenly passed over in selecting for the Special Room, Miss Coy, with some assistance from Dr. Manuel, made careful Binet tests of 20 pupils in our Control Group. Of these 20, six were selected by their teachers as being "average pupils," and six more were selected by their teachers as being "below average in their school work"; five were examined because they showed signs of special talent in drawing; two because of remarkable showing in certain of the group tests (the two pupils transferred to our Special Room in March) and one because he showed such remarkable ability in language, coupled with such poor ability in arithmetic. Of these 20 pupils, six turned out to have I. Q's higher than the median I. Q. of our Special Group, yet three of these six had been definitely characterized as "average in school work."

Another matter of interest: in order to see in what respects our Special Sixth excelled our Special Fifth, the various Binet tests were classified roughly into various categories from which it appeared that the Sixth surpassed the Fifth chiefly in vocabulary and in the

more difficult kinds of reasoning ability;* the former difference would appear to be due largely to difference in duration of school training; the latter doubtless to difference in school training, plus difference in maturity.

2. *The Four Form-Boards.* The results from the two Healy picture puzzles and the two Knox form-boards indicate that in the type of mental activity demanded by these tests "bright" children are not necessarily more competent than "average" children. Numerous pupils from the Control Group made better records than the average scores of our Special Group.

3. *Picture-Arrangement Test.* Five sets of Foxy Grandpa pictures were taken from the sets originally prepared and tested by Fraser and Whipple. Certain difficulties of method and of scoring that have since been partially circumvented by Miss Bowler† prevented us from getting out of this test all that it promises. Five of the 14 pupils tested from the Control Group surpassed the average performance of the Special Group.

4. *Healy-Pintner Picture Completion Test.* The method followed was that described in Chapter III of *The Picture Completion Test,* by Pintner and Anderson. In this book the writers anticipate that the ability demanded by the test is like that demanded by language-completion tests, but our results do not accord with this anticipation; on the contrary, the members of our Special Group do no better than would be warranted by their chronological age. Our scores are: for the Special Fifth, poorest 172, average 442.6, best 589; for the Spe-

*The Special Fifth surpassed the Special Sixth in memory for digits and in tests dealing with space and form (except the 16-year code test): it equalled the Special Sixth in defining abstract words, in the dissected sentences test, in the 10 and 12-year tests for seeing resemblances, in the 14-year induction test and in the ball and field and the president and king tests.

†*Psychol. Clinic,* April 15, 1917.

cial Sixth, poorest 286, average 482, best 646. The score 442.6 is about the 53d percentile for 10 years; score 482 is about the 56th percentile for 11 years, according to Pintner. If time be included in the scoring, the case is even worse. The fact that many adults take a hypercritical attitude toward the picture, are disturbed by its lack of perspective and unnatural collocations of scenes, may possibly be reflected in the attitude of some of our bright pupils.

5. *Painted Cube Construction Test.* We used the plan advocated (in a letter) by E. A. Doll, of the Vineland Training School, but had to modify his directions to secure better grasp of the problem. The test requires the assembling of 27 cubes to make one large cube painted on the outside only. It proved more difficult than was expected; the time for solution ranged from 6.5 to 103 minutes (median about 20 minutes), *i. e.*, the ease of solution varies enormously with different children. It promises to become a valuable test, particularly when certain simplified variants of it, like asking for the construction of the bottom layer only, have been worked out more carefully.

6. *The Porteus Maze Tests.** This series of tests, devised by S. D. Porteus, has been reported by several writers as affording fairly good correlations with Binet mental age. We did not find it satisfactory at all. The series did not differentiate our Special Group from the 10 pupils tested from the Control Group, nor did the results check up with the mental ages previously determined by the Binet method.

7. *Pyle Marble-Sorting Test.* Through the courtesy of Dr. W. H. Pyle, of the University of Missouri,

*These tests were administered by Miss Harriett Berninger, Assistant in Education.

we were permitted to borrow his original apparatus and to have access to the unpublished master's thesis of Miss E. Waltner, *The Psychology of the Negro,* in which methods and results for marble-sorting are embodied. This test measures the speed with which children learn at a given signal to select marbles of given sizes or colors and to bring them, by a designated series of simple movements, to given positions. Our results indicate that our Special Group fail to reach the standard performance of their chronological age in Trial I, while their improvement in Trial II is somewhat greater than their performance in Trial I would lead us to expect. This low ability in a learning test that combines manual skill with intelligent guidance may be contrasted with the remarkably high records of this Group in the learning test in multiplication. Correspondence with Dr. Pyle has failed to account for the poor showing of our pupils in comparison with his results at Columbia, Missouri.

8. *Easy Directions and Hard Directions Tests.* These are the rather well-known tests described by Woodworth and Wells in their *Psychological Monograph* on "Association Tests." Our Special Fifth reaches the 20th percentile found by Dr. W. S. Miller for high-school freshmen,* our Special Sixth the 53d percentile for the freshmen. This group, in fact, is in this test advanced about three years beyond the standard performance. Several pupils were found in the Control Classes that surpassed these averages of the Special Classes.

The scores (per cent. of accuracy divided by the time in seconds) run as follows:

*In an as yet unpublished doctorate thesis from the University of Illinois, entitled "Mental Tests and the Performance of High-School Students as Conditioned by Age, Sex and Other Factors."

Grade	*Easy Directions* Poorest	Aver.	Best	*Hard Directions* Poorest	Aver.	Best
Special Fifth	.344	.590	.736	.206	.372	.529
Special Sixth	.486	.774	1.045	.312	.519	.862

9. *Easy and Hard Opposites Tests.** An easy opposites test was given to the Special Group as a group test in March, 1917. The stimulus words were *poor, strong, sick, slow, young, outside, sharp, thin, large, beginning.* The responses were written, and each pupil recorded his own time by glancing, when he finished, at the Whipple seconds clock. Later, a hard opposites series (*enemy, attractive, over, deceitful, public, talkative, proud, calm, to hasten, to hate*) was given as an individual test to the same group and also to 22 members of the Control Group. In this test each stimulus word was typewritten on a card and each response was timed with a stop-watch.

We found, what other users of this test have found, that it serves well as an index of intelligence: thus, 13 of our 15 Special Fifth pupils surpass the average performance of the Control Fifth; similarly, of the 12 pupils tested in the Control Sixth, the only two that surpassed the average performance of the Special Sixth were pupils with I. Q.'s of 104 and 130.

10. *The Analogies Test.*† This test demands the perception of relatively abstract verbal relationships and has been found to be one of the best indexes of this important aspect of general mental ability. From the results obtained by Dr. W. S. Miller with List C in his testing of all four classes in the Urbana High School, we had supposed that the test could not be used in the 5th or 6th grade, at least that List C would be impossible.

*The hard opposites tests were administered by Miss Dora Keen, graduate student in Education.

†For details of administration, see the writer's *Manual of Mental and Physical Tests*, Second Edition, Test 34A, Part II. pp. 89-94.

Actually, the average performance of our Special Fifth (in October, 1916) is as good as 15 per cent. of high-school freshmen, while the Special Sixth averages as good

Average Times, in Seconds Per Card, Analogies Test

	List A			List B			List C		
Grade	Poorest	Aver.	Best	Poorest	Aver.	Best	Poorest	Aver.	Best
Sp. Fifth	12.89	5.70	3.11	13.08	9.54	3.75	24.00	17.85	8.76
Sp. Sixth	6.28	4.10	2.90	12.56	7.72	4.39	22.56	15.94	9.77

as 30 per cent. of the freshmen. Moreover, some of the best scores obtained are truly remarkable: one of our Special Fifth girls reached a score surpassed by only 30 per cent. of high-school seniors, or in other words did better than the average pupils *seven years older* than she is; another, our girl with the 167 I. Q., confirmed our diagnosis of her ability by reaching the median score of high-school juniors, or, in other words, by doing as well as the average pupil *six years older* than she is. Remarkably high scores were made by at least a third of the Special Group. When we tested 25 pupils in the Control Group we unearthed there seven who surpassed the corresponding average for the Special Group. Of these seven, two were the pupils Y35 and F34 afterward transferred to the Special Room. We feel confident that the analogies test brings out an ability that is decidedly symptomatic for the purposes of selecting gifted children.

B. GROUP TESTS

11. *Cancellation.* The Special Group alone, in December, 1916, and January, 1917, were given four cancellation tests—triangles and circles from a sheet of geometrical forms and 7's and 4's from a sheet of digits. The material and the method of using it for group testing have been described by me elsewhere.* The time-limit

*Manual of Mental and Physical Tests, Part I, Test 26, pp. 309-310.

of 2 minutes proved satisfactory, except with the cancellation of circles, which is so much easier that several pupils finished in 1 minute, 25 seconds. The scores (one unit for each cancellation, less two units for each omission) are hardly worth reporting here, because we have no data for comparison and because the time-limit method turned out to be unsatisfactory on the whole. The cancellation test has steadily refused to yield good correlations with general intelligence, and if undertaken at all, should be conducted with the use of the seconds clock recommended in my *Manual*. In general, our sixth grade surpassed our fifth grade. The foot-rule correlation between cancelling 4's and 7's is 0.77 in the Special Fifth and 0.20 in the Special Sixth, that between cancelling 7's and cancelling triangles is 0.51 in the Special Sixth.

12. *Memory ("How Lincoln Helped the Pig" and "The Marble Statue").* October 25, 1916, the 'logical memory' test known as "How Mr. Lincoln Helped the Pig" was given to the Special Group; it was administered and scored as described by the writer.* The first reproduction was called for directly after the reading of the passage by the examiner, the second reproduction two weeks later. In the latter part of January, 1917, the same test was given in the same way to the Control Group. On October 26th, another similar test, known as "The Marble Statue,"† was given to the Special Group and it was likewise given to the Control Group about three months later. Unfortunately, this latter group was tested only for immediate reproduction with this second memory test. The chief results, in terms of average number of ideas reproduced, are given herewith.

Ibid. Part II, Test 39, pp. 207-208.
†*Ibid.* Part II. p. 208.

1. *"How Lincoln Helped the Pig;" Average Ideas Reproduced*

A. Immediate Reproduction

Special Fifth	23.40	Special Sixth	24.46
Control Fifth	22.97	Control Sixth	22.59

B. Deferred Reproduction (2 weeks)

Special Fifth	21.20	Special Sixth	22.00
Control Fifth	16.34	Control Sixth	18.22

2. *"Marble Statue;" Average Ideas Reproduced*

A. Immediate Reproduction

Special Fifth	35.40	Special Sixth	38.53
Control Fifth	29.39	Control Sixth	31.59

B. Deferred Reproduction

Special Fifth	30.70	Special Sixth	32.50
Control Fifth	——	Control Sixth	——

It will be noted that the superiority of the Special Group over the Control Group is more evident in the Marble Statue test, which is at once more difficult and also richer in possibilities of good scores; further, that the superiority is more evident in deferred than in immediate reproduction. Generally speaking, our Special Group can recall as many ideas two weeks after hearing a passage read as the Control Group can recall directly after hearing it read. This suggests that for gifted children reviews need not be so frequent nor so detailed as for ordinary children—a matter that will be discussed more fully in a later chapter.

13. *Memory ("The Dutch Homestead").* This test, like the preceding, followed the directions given in the writer's *Manual*; it was distributed to each pupil in printed form and he had two minutes to read it before writing what he could recall. Unfortunately, there was no deferred reproduction and no opportunity to test the Control Group. We have compared the results with the distributions obtained by Dr. W. S. Miller in the Urbana High School,* and note that there is an unexpectedly wide distribution of scores (8 to 42 in the Special

*In the doctorate thesis of the University of Illinois, already referred to and as yet unpublished.

Fifth and 9 to 46 in the Special Sixth), also that the median of the Special Fifth reaches the 18th percentile, and that of the Special Sixth the 21st percentile of high-school freshmen, while some of our highest scores equal the median records of high-school sophomores and juniors.

14. *Manuel Perceptual Learning Test.* This test was given by Dr. Manuel to the Special Group only in his endeavor to measure ability to reproduce linear relations after visual exposure. The children were shown a series of cards on which were drawn end-to-end combinations of 4, 6, 8 or 10 straight or curved lines.* A given card was shown about 5 seconds, when the children tried to draw it. The same card was shown again, and a new drawing made, and so on for five exposures for each card. The score was obtained by a somewhat elaborate method of computing the degree of resemblance between the fifth drawing and the exposed card.

The results do not indicate any sure correlation with general intelligence, for while the correlation with mental age came to .59 in our Special Fifth, it was practically zero with our Special Sixth.

15. *Letter Substitution Test (Thurstone).* This test was developed by Dr. L. L. Thurstone, of the Carnegie Institute of Technology. The key at the top of the page comprises 20 words, like *umbrella, equinox,* etc., while the substitutions that are to be made are the writing of the last letter of each word after its first letter, as this appears below in a series of vertical columns (10 groups of three columns each). For example, whenever *u* is printed in the column, *a* is to be written against it (as

*The figures were similar to those used by Judd and Cowling in their Studies in Perceptual Development, *Psychological Review Monographs*, 8: 1907, 349-369.

shown in the key word *umbrella*) ; whenever *e* is printed, *x* is written, etc. The key remains in sight. The test proceeds for 10 minutes, with provision for starting on a new group of columns each minute. The score is indicated by the total number of correct substitutions in 10 minutes. We also asked each pupil, after the 10-minute trial, to write the key words from memory.

The chief results of the test administered to the Special Group November 27, 1916, are, in number of substitutions:

	Poorest	Median	Best
Special Fifth	65	112	177
Special Sixth	95	184	287

Unfortunately, we have no control records with which to compare. The test seems to be a good, simple test of rapidity of learning. The best record in the Special Fifth was made by a pupil who also made the best record for that grade in the Pyle learning test (marble-sorting) and in the Multiplication practise test, and the extraordinary record in the Special Sixth, 287, was made by the pupil whose record in the Pyle learning test was best for that grade.

16. *Digit-Symbol Substitution Test.* This test and the manner of administration followed exactly the directions specified by the writer,* including the preliminary blackboard explanation. The test, then, was continued for 4 minutes, and the score could be arranged to show the number of substitutions by 30-minute periods.

The average performance was 63.1 for the Special Fifth and 69 for the Special Sixth. The test was not given to our Control Group, but it was planned instead to compare our score with the averages per minute published by Pyle for the same test. These averages are

**Manual*, Part II, Test 37 (B), p. 186.

classified by sex and age thus: for the years 9 to 12, inclusive, for boys; 12.6, 15.4, 16.3 and 19.1 and for girls: 15.7, 18.8, 18.5 and 22.7. The median age of our Special Fifth is 10 years, 6 months; its boys average 14.5 and its girls 15.5 in this test—both slightly below the age standard. The median age of our Special Sixth is 11 years, 7 months; its boys average 15.6 and its girls 19.3—both again slightly below the age standards set by Pyle. Since, however, his averages are based on about half a hundred cases only and are accompanied by average deviations of about 4 units, it would be fair to say that our Special Classes just about fulfill expectations for their chronological ages in this substitution test.

The performance by half-minute intervals is summarized herewith.

Average Number of Correct Substitutions by 30-Second Intervals: Digit-Symbol Substitution Test

Intervals	1	2	3	4	5	6	7	8
Special Fifth	4.54	5.69	8.15	9.31	7.00	9.46	7.69	8.08
Special Sixth	5.93	9.08	8.00	10.10	8.08	11.20	8.23	9.15

17. *Character-Traits Directions Test (Thurstone).* The test is one of the type designed to present a problem of classification on a two-fold basis. Forty traits, like *reliable, lazy, studious,* etc., are presented, typewritten. The task is to designate by a plus sign the desirable and by a minus sign the undesirable qualities, with the added proviso that the sign shall be made in the left-hand of the two columns provided for the purpose if the word contains the letter *a,* but in the right-hand column if not. The letter *a* is printed at the head of the left-hand column. The test was administered to the Special Group in January, 1917, as a group test, with a time-limit of 3 minutes, and scored by rights minus twice the wrongs. The minimal, median and maximal scores for our Spe-

cial Fifth are —1, 11.4 and 27; for our Special Sixth, —32, 15.25 and 25, respectively. There is some question whether this scoring is satisfactory. We need further information to speak definitely about the usefulness of the test: the idea of testing speed and accuracy of simultaneous classification under two independent categories seems an excellent one.

18. *Word Building, I and II (Whipple).** Both sheets of this test were given to the Special Group October 24, 1916, and to the Control Group about the end of January, 1917.

The averages, as the accompanying table shows in-

Averages, Word Building, I and II

Special Fifth 21.00	Special Sixth 24.70
Control Fifth 19.06	Control Sixth 21.27

dicate in general a superiority of the Special over the Control Group and of the Sixth over the Fifth Grade. Similar results can be obtained by comparing these scores with the percentile distributions for 11-year and 12-year old boys, as given in my *Manual*. The average of the Special Group is close to the median while the average for the Control Group is near the 38th to 40th percentile by this comparison. In general, then, the Special Group does do better than the Control Group in word building, but on the other hand the range of distribution is so wide that these averages have a considerable degree of unreliability; there are numerous poor as well as numerous good scores among the Special Group, so that the test on that account is less diagnostic than some others we tried.

19. *Terman and Childs Completion Test.*† When this test was given to our pupils on December 8, 1916,

*_Manual_, Part II, Test 47, pp. 274-283.

†Described as Completion Test No. 4 in the *Manual*, Part II, pp. 285-7.

they had already had experience with the Trabue completion tests, so that the general problem was familiar. Five of them also had heard at some time or other the story, *The Strength of the Eagle,* on which the test is based.

When these five pupils are excluded and the results are scored as prescribed by Whipple for a 10-minute time-limit, they run:

	Poorest	Median	Best
Special Fifth	12.8	22.3	38.0
Special Sixth	17.4	28.2	41.2

We have no comparison records from our Control Group. The scores published by Terman and Childs are based on a 15-minute time-limit, while those reported by Fraser for a 10-minute time-limit do not run below 13 years. The test had value for us mainly in the manner in which it ranked pupils within the Special Group.

20. *Terman Completion Test.** The Special Group received this test three days later than the preceding test. After the passage *Why the Mole is Blind* had been read to the pupils once, they were allowed 7 minutes to fill in the deleted text. Scored by giving 2 for each correctly filled blank, the minimal, median and maximal scores are: "Special Fifth, 41, 74, 171; Special Sixth, 28, 86, 153. We have no comparison records. Within the Special Group it may be noted that pupils with high I. Q.'s make high scores in this test, though pupils with low I. Q.'s do not always make low records in it.

21. *Trabue Language Scales, B and C.*† These two scales were given to the Special Group October 19 and 23, 1916, and to Rooms F, G and Y from two to three months later.

*Prescribed as Completion Test No. 3 in the *Manual.*
†R. M. Trabue. *Completion Test Language Scales.*

Comparing our results with the tentative standards laid down by Trabue it appears that our Control Fifth reaches about half way between his sixth and his seventh-grade standards; while our Special Fifth median just reaches the eighth-grade standard and our Special Sixth

Scores for Trabue Scales B and C Combined

	Poorest	Med.	Best		Poorest	Med.	Best
Special Fifth	21	26.7	33	Special Sixth	21	27.5	36
Control Fifth	12	23.2	32	Control Sixth	18	23.3	32

almost the ninth-grade standard. That is, our regular classes run almost a year ahead, and our selected pupils about three years ahead, of the Trabue standards. The best record in our Special Fifth reaches, and the best record in our Special Sixth exceeds, Trabue's standard for the *twelfth* grade. In comparing these records it will be noted that our Special Group took the tests two or three months before the Control Group.

22. *Trabue Language Scales, J and K.* These two scales were given to the Special Group March 13, 1917, and to the Control Group March 14 to 17. The method was like that with Scales B and C, except that the time-limit was five minutes instead of seven. Trabue gives no standards for these scales. Comparison within our own groups gives the appended records.

Scores for Trabue Scales J and K, Combined

	Poorest	Med.	Best		Poorest	Med.	Best
Special Fifth	8	13.17	20	Special Sixth	6	15.50	21
Control Fifth	2	9.75	18	Control Sixth	2	10.54	19

The differences here are striking; they corroborate the results with Scales B and C and prove conclusively that the kind of ability needed for the completion test is found in much greater quantity among the selected pupils.

23. *Completion of Number Series (Thurstone).* In

February, 1917, we tried with the Special Group and with the Control Group a test, devised by Dr. Thurstone, composed of six series of 10 numbers each; each series was followed by four blank spaces into which the pupils were to write numbers that would continue the series on the principle used for that series of 10 numbers. A sample easy series is:

2 4 6 8 10 12 14 16 18 20 — — — —

A sample hard series is:

2 5 9 15 19 22 26 32 36 39 — — — —

The time-limit was 3 minutes. The scoring was finally arranged to give credit roughly in proportion to the difficulty of each series; thus, the correct completions of the two series shown above were scored 1 and 12, respectively.

No results will be shown here for this test. It was found to be much too difficult for pupils of these grades —nearly one third of the pupils in the Control Group made zero scores, as did four pupils in the Special Fifth and one in the Special Sixth.

24. *Completion of Number Series (Coy).* Deeming the idea of testing generalization by the use of number series too valuable to discard without another attempt, I suggested the trial of much simpler series arranged in gradually increasing difficulty. Miss Coy worked out such a test, composed of 13 number series. A scheme of credits, ranging from 1 point to 5 points, was also worked out empirically. The test was given to both the groups in March, 1917. The pupils marked the point reached by them at the end of 3 minutes, but continued the test until finished. Record was made of the total time of each pupil. The total credits obtained in 3 minutes did not serve well to differentiate the groups; neither did the at-

tempt to figure the time per correct solution. We finally used simply the total credits for the entire test, disregarding speed, and obtained thereby the following:

Scores for Number Series Completion (Coy)

	Poorest	Med.	Best		Poorest	Med.	Best
Special Fifth	0	10.63	31	Special Sixth	0	15.50	31
Control Fifth	0	6.58	27	Control Sixth	0	10.50	27

The distributions show fewer zero scores than with the Thurstone form of the test, and these might, we think, have been further reduced by some sort of preliminary blackboard explanation or opportunity for perhaps one or two series as a fore-exercise. As it is, the test seems likely to be quite useful. Note that the Special Group clearly surpasses the Control Group, and that the Special Fifth is as good as the Control Sixth, also that the highest scores were made in the Special Group. Of the four zero scores made in the Special Group, two were by pupils who failed in final examinations and stood poorly in most of our tests; similarly, four of the very high scores in the Control Group were made by pupils that other tests and the judgment of teachers had shown should have been in the Special Group.

25. *Original Analogies.* Following the idea used by Miss L. M. Chassell,* we proposed to the pupils of the Special Group, November 6, 1916, after they had all taken the regular individual analogies test already described, that they should try their hand at inventing analogies. Fifteen minutes was allowed. The test was conducted somewhat informally; pupils that had difficulty were given some individual attention at times during the fifteen minutes.

Certain difficulties were encountered in scoring the results and we have no data for comparison with our

*Tests for Originality, *Jour. of Educ. Psychol;* 7: June, 1916, 317-328.

Control Group. The results that were obtained indicate that further experimentation with this test and others like it would be worth while. One point of interest is the very high correlation between this test and the Winch composition test. It is possible that the making of original analogies reveals better than does the solving of regular analogies, the ability to handle abstract relationships of the verbal variety.

26. *Equivalent Proverbs.* This test has been used by several psychologists, among them Dr. H. A. Ruger and Dr. W. D. Scott. I am unable to say who originated it. A set of English proverbs is printed on one half of the page; a set of English translations of Arabian or African or other proverbs that present the same ideas is printed on the other half of the page, but in a different order. The examinee is to set against each English proverb the number of the foreign proverb that is equivalent to it in meaning. It is clear that the test demands the appreciation of metaphorical allusions. In a way it might be thought of as a condensed form of the 'interpretation of fables' test.

The material used with the Special Group October 11 was known as Form VI and that given December 4 as Form I and Form II. These three sets of equivalent proverbs were developed in 1916 by members of the Bureau of Salesmanship Research, Pittsburgh, Pa., who were doing research work in mental testing under my direction. No. VI is made up of 13 pairs, the others of only 8 pairs, of proverbs; VI is intrinsically more difficult and ought to have come last in order of presentation. Because the time varied so much we tried to combine speed and accuracy of work by computing the average time per correct answer, though the plan is open to criticism

with this particular test. The tests were given to the Control Group between December 14, 1916, and January 12, 1917, under somewhat altered conditions of time allowance and method of printing the text of Form VI. The altered conditions, so far as we could estimate, did not appreciably favor either the Special or the Control Group. From the median performance, which is fairer than the average on account of certain very low scores, it is clear that this test serves remarkably well to differentiate the gifted pupils.

Equivalent Proverbs; Time per Correct Answer

	Poorest	Med.	Best		Poorest	Med.	Best
Special Fifth	190.0	132.4	40.5	Special Sixth	177.0	72.9	41.7
Control Fifth	419.0	154.0	40.5	Control Sixth	576.0	119.0	39.6

27. *Reasoning Tests, III, V and VI. (Bonser).** These tests are of a non-arithmetical character and thus are preferably dealt with separate from the Bonser Tests I and II, which are classed with our educational tests. They comprise various forms, such as completion of a sentence to make sense, crossing out the one of two words in a sentence that makes poor sense, checking correct reasons, valid definitions, etc. Following Bonser's method, we had to determine our own time-limits, with the following results:

	5th grade	*6th grade*
Test III A	124 sec.	124 sec.
Test III B	195	180
Test V A, B	86	70
Test V C	57	35
Test V D	24	24
Test VI	90	75

The tests were administered to the Special Group December 5-7, 1916, and to the Control Group mostly about one month later.

*F. G. Bonser. *The Reasoning Ability of Children of the Fourth, Fifth and Sixth School Grades.* Teachers College Contrib. to Educ., No. 37, 1910.

The results show that while a few very poor records were made in the Special Group, yet, on the whole, this combination of 'reasoning' tests serves excellently well for separating the Special from the Control Group; in fact, the Special Fifth is better in reasoning than the Control Sixth. The exceptionally high record made by one pupil in the Control Fifth represents a child that was later on transferred to the Special Fifth. The summary of scores here given comprises all six parts of these tests taken collectively.

Bonser Reasoning Tests III, V and VI

	Poorest	Med.	Best		Poorest	Med.	Best
Special Fifth	27	43.5	76.5	Special Sixth	31.5	55.0	95.0
Control Fifth	5	30.5	91.0	Control Sixth	13.0	40.5	86.0

28. *Inference Test (Thurstone).* The test form contains 32 arguments in syllogistic form, all of them dealing with the stature of Smith, Jones and Brown, *e. g.*, "Smith is taller than Brown; Jones is shorter than Brown; therefore Brown is taller than Smith." Each argument is to be marked + if true, – if false. Seven minutes was allowed. We have not been able to try different methods of scoring this test. Logically, since the examinee, by nearly guessing, has a one-to-one chance of marking any argument correctly, a suitable score would appear to be the number right less twice the number wrong. On this basis scores might range from –64 to +32; our Special Fifth scores did range from 2 to 29, median 8.5; our Special Sixth scores from –8 to 22, median 5.25. Note that the test is difficult; that the fifth grade surpasses the sixth (this by marking fewer arguments and making fewer errors); that one pupil makes the remarkable score of 29 (Pupil No. 1, who does exceptionally fine work in all reasoning tests). We have

no data for comparison with other elementary-school or high-school pupils.

In terms of number right the scores were: for the Special Fifth, median 13.5, range 8 to 29; for the Special Sixth, median 13.5, range 6 to 25.

29. *Reasoning Test (Thurstone).* This test form contains 20 arguments, more varied in content and style than those of the preceding test. It was given to the Special Group December 14, 1916, and to the Control Group February 7 and 8, 1917. The Special Group worked seven minutes, but also indicated the point reached in five minutes. The Control Group worked for five minutes.

When we scored this test by the formula R-2W we found an anomalous condition: the Special Fifth excelled the Control Fifth, but the Special Sixth was inferior to the Control Sixth—this despite the superiority of the Special Group in other tests involving abstract verbal relationships, like Equivalent Proverbs, Bonser Reasoning and Analogies. On this account we prevailed upon Dr. Thurstone to survey our data, with the result that scoring by giving credit to right answers with no penalty for wrong answers was found by empirical testing to bring this test into line with the other reasoning tests and to qualify it for consideration for selecting gifted children, though it is undoubtedly very difficult for children of these grades.

Score by Rights in Reasoning Test (Thurstone)

	Poorest	Aver.	Best		Poorest	Aver.	Best
Special Fifth	5	9.66	15	Special Sixth	8	11.00	14
Control Fifth	2	7.59	12	Control Sixth	2	7.83	16

30. *Hand Test (Thurstone).* The printed form presents a series of 49 drawings of a hand shown in all sorts

of positions. Three minutes is allowed in which to indicate for as many hands as possible whether they are right or left hands. The score is the number of rights minus the number of wrongs. The Special Group took the test December 15, 1916; the Control Group January 12-15, 1917. Our records show a preponderance of low scores with a few very high records. The distribution for the several groups is virtually the same, and no difference can be detected between the gifted pupils and the others. The peculiar ability that is measured is apparently not one that is symptomatic or constitutive of general intelligence.

31. *Spatial Relations Test A. (Thurstone).* This test is yet another of those designed by Dr. Thurstone. It is difficult to explain without showing the copy in detail. It was difficult to explain to the children what was to be done with the copy when it was before them. On this account and because our results show that the test has little relation to general intelligence, but is more akin to the Flag Test and the Hand Test, we shall make no attempt to enter further into it here.

32. *Punched Holes Test (Thurstone).* In February, 1917, we gave to both Special and Control Groups, the Thurstone Punched Holes Test. This has a certain similarity to the paper-folding test of the Binet series, which is placed by Terman in Year XVIII. The test sheet, by drawings and verbal description, explains to the examinee that he is to imagine a square of paper folded once along its diagonal and then again along an axis at right angles to the first fold; in the second section of the test, there is yet another fold. The examinee then has to show by pencil in blank squares where holes would appear in the paper if punched through at certain indi-

cated points and then unfolded. From this description it will perhaps be clear that the test seems to be very decidedly one demanding a special form of ability to manipulate objects in visual or visuo-kinesthetic three-dimensional space. There is added, however, the possibility of working, at least after the first few squares are done, by means of a generalized principle, and it may be that the striking results we have obtained depend on that aspect of the test.

Scores in Punched Holes Test

	Poorest	Med.	Best		Poorest	Med.	Best
Special Fifth	3	8.25	34	Special Sixth	2	12.25	36
Control Fifth	0	4.23	16	Control Sixth	0	5.30	29

The only directions given were: "Do what it says to do." The time-limit was set at 10 minutes, which turned out to be too short for any of our pupils to finish. In the absence of scoring instructions, we have simply given one credit for each hole correctly placed, with no deductions for errors. The results are sufficiently interesting to warrant a reproduction of the distribution areas for the two grades; it will be noted thereon that there are a few excellent records in which the members of the Special Group appear far more frequently than those of the Control Group. In both grades the averages and medians for the Special Group are over twice as good as those for the Control Group.

33. *Flag Test (Thurstone).* This is another of the tests designed by Dr. Thurstone to bring out capacity to handle spatial relations. It is a mimeographed sheet bearing typewritten directions and 21 simple drawings of pairs of flags. The examinee is to mark with a plus, pairs that show the same face of the flag, with a minus, pairs that show different faces. (It should be understood that the area occupied by the stars in the United

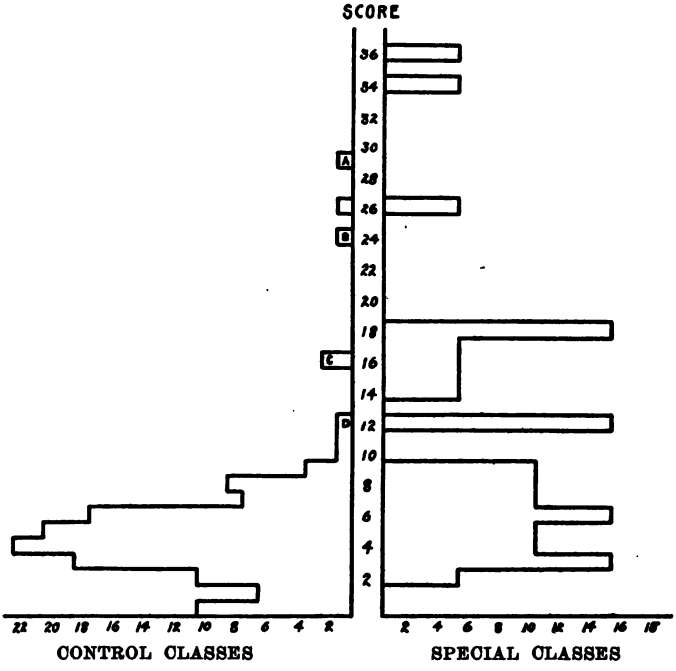

FIG. I.

Comparison of Scores of Special and of Control Classes in the Punched Holes Test.

Here in Fig. I, since the Special Classes actually contained 30 pupils and the Control Classes 148 pupils, the number of cases on the right-hand side of the diagram has been multiplied by five to produce an approximate equivalence in the two distributions. It is of special interest to note that several of the high scores here assigned to members of the Control Group were obtained by pupils who were shown to be gifted. Thus the score marked *A* was made by Pupil G-38 who was picked by the other mental tests and by her teacher as wrongly retained in the Control Group; the score marked *B* was made by Pupil F-34, whose I.Q. is 135 and who was later transferred to the Gifted Class; the score marked *C* was obtained by Pupil F-21, who was ranked both by the other tests and by the teacher as a possible candidate for the Gifted Class; and the score marked D was obtained by Pupil Y-35, whose I.Q. is 167 and who was later transferred to the Special Class. (See Chapter VII for a discussion of these cases.)

On the other hand, of the scores below 9 points here assigned to pupils in the Special Class five (or 25 'squares' on the diagram) were obtained by pupils shown by the other mental tests to have been wrongly included in the Special Class. If these corrections are made, the reader will observe, the diagnostic merit of the Punched Holes test becomes still more strikingly evident.

States flag is demarcated by a small rectangle within the large, also that the flags were shown in a position 90 or 180 degrees from normal.) This test was administered, after appropriate blackboard explanations, to the Special Group and to the Control Group, in February, 1917. The time-limit of 5 minutes proved too long for about one seventh of the pupils. The scoring was rights minus twice the wrongs. The results are ambiguous for the placing of this test. In the 5th grades the Special Group is clearly superior to the Control Group, whether we take averages or medians. In the 6th grade the Special Group shows the higher average, but the Control Group the higher median (with six perfect scores). The figures follow:

Scores in Flag Test (Thurstone)

	Poorest	Med.	Av.	Best		Poorest	Med.	Av.	Best
Special Fifth	−21	15.12	6.87	21	Special Sixth	−16	4.50	5.73	21
Control Fifth	−30	−3.37	−3.29	21	Control Sixth	−27	6.50	3.68	21

34. *Steacy Drawing Construction Test, 1-40.* This test was forwarded by its originator* with a few directions but not sufficient to make us sure that we followed his methods. We had also to devise our own scoring. The general scheme is to place before the examinee a set of 20 drawings, like so many small and quite simple units in a geometrical linoleum design and likewise another set of 20 drawings which reproduce only the upper left-hand quarter of the first 20 designs. The order on the two sheets differs; the second drawings are numbered, and the examinee is to find out which of the completed designs is made from the Quarter-section No. 1, No. 2, etc., and number them accordingly. After a preliminary blackboard explanation, we permitted the pu-

*Mr. F. W. Steacy, who was using it for certain investigations at Columbia University, 1916-17. See his *Interrelations of Mental Abilities* (in press).

pils to use all the time they needed, but papers were submitted as soon as finished, the time was noted, and they were scored by dividing the time into the total number of correct numberings. The same process was then repeated with a second set of drawings and quarter-sections, numbered 21 to 40. The median scores (seconds per correct solution) run: Special Fifth 37.38, Control Fifth 45.75; Special Sixth 33.58, Control Sixth 33.83. One of the highest scores is made by a boy in the Control Group that had been under study for his unusual ability in drawing. However, the test clearly has little to recommend it for measuring general intelligence.

35. *Steacy Drawing Construction Test, 41-100.* This differs from the preceding test in that the examinee is asked to draw a complete design from the upper left-hand quarter of a design which is shown as a pattern. The designs use straight lines only. They are to be drawn on backgrounds provided in the mimeographed test sheet. The background for each design is a square subdivided into 16 squares, all indicated by light dotted lines. The test demanded careful preliminary explanation with blackboard demonstrations. To accomplish the 60 designs took about three 30-minute periods—obviously too long for classroom testing. Thirty patterns would be quite sufficient. We scored each pupil in terms of time in minutes per correct design, and obtained the following results.

Steacy Drawings, 41-100. Minutes per Correct Drawing

	Poorest	Median	Best		Poorest	Median	Best
Special Fifth	4.48	1.146	0.606	Special Sixth	1.94	1.046	0.669
Control Fifth	60.00	1.701	0.588	Control Sixth	15.00	1.229	0.655

These results show that especially in the 5th grade the test has some diagnostic value. Examination of in-

dividual records indicates that a child with mediocre general intelligence may get a good score if he has some talent for drawing and skill in the use of his pencil; on the other hand, pupils with superior general intelligence are able to make good scores, even when they exhibit no special talent in drawing. This part of the Steacy test is better as a measure of intelligence than the first part, if our data are to be held reliable.

Chapter IV

THE EDUCATIONAL TESTS AND THEIR OUTCOMES

The tests which we have listed as primarily educational rather than mental tests have to do with spelling, writing, drawing, arithmetic, reading and composition.* They will be discussed in the following order (continuing the numbering from the preceding chapter):

36. Spelling (Buckingham test)
37. Spelling (Ayres tests)
38. Handwriting
39. Drawing (church and snowball fight)
40. Drawing (horse)
41. Drawing (toy wagon)
42. Drawing (esthetic appreciation test)
43. Arithmetic (constant increment test)
44. Arithmetic (error-checking test)
45. Arithmetic (practise test in multiplication)
46. Arithmetic (Courtis, Series A and B)
47. Arithmetic (Woody tests, Series A)
48. Arithmetic (Woody-McCall tests, Series B, I and II)
49. Arithmetic (Bonser Reasoning tests, I and II)
50. Reading (Thorndike visual vocabulary test)
51. Reading (N. Y. Ventilation Commission vocabulary test)
52. Reading (Thorndike scale alpha)
53. Reading (Thorndike scale alpha 2, Part II)
54. Composition (punctuation test)
55. Composition (Winch tests)

*For references to all these and many other educational tests, together with a discussion of methods, standards and results in the measurement of classroom performance, the reader is referred especially to *The Seventeenth Yearbook of the National Society for the Study of Education, Part II*, 1918, entitled "The Measurement of Educational Products," which presents an authoritative survey of this field, prepared by the National Association of Directors of Educational Research. Another convenient reference is W. S. Monroe, J. C. DeVoss and F. J. Kelly. *Educational Tests and Measurements*. Boston, 1917.

36. *Buckingham Spelling Test.* This test comprises about 20 sentences presented as an exercise in dictation, in which a certain 50 words are scored for spelling and the weights to be given for misspelling each word ascertained by reference to the author's tables.* This method of scoring we feel to be too complex, when handled to furnish data for the comparison of individuals, to pay for the labor expended. We have found, however, that our Special Fifth ranks 22 per cent. above the fifth-grade performance specified by Buckingham and our Special Sixth, 17 per cent., above his specifications for that grade. The Special Fifth is about 8 per cent. below the Special Sixth.

37. *Ayres Spelling Test.* On three different days in October our Special Classes were given Ayres' Lists N, R, and U. The average scores made by both grades on all these lists were distinctly above the average set by Ayres for their grades. Roughly, the grades attained

Average Scores in Ayres Spelling Tests

	List N	List R	List U
Special Fifth	91.6	72.4	55.9
Ayres Standard	88.0	66.0	42.0
Special Sixth	97.1	91.3	75.3
Ayres Standard	94.0	79.0	58.0

are nearer the standard of the next grade above than the normal standard; in fact, with List U the Special Sixth score of 75.3 is far superior to the 66 which is standard for seventh grades. The results, therefore, confirm those of the Buckingham test.

38. *Handwriting.* In October the pupils were asked to copy a paragraph from a simple story, with no suggestion that quality of writing was to be graded. Later

*B. R. Buckingham. *Spelling ability; its measurement and distribution,* Teachers College Contributions to Education, 1913. See especially p. 51.

each sample was graded by each of sixteen students in my class in educational measurement, both by the Thorndike and by the Ayres scale. The ranks obtained by the two scales are closely similar in most cases. The averages for the two grades are not much different. By the Thorndike scale the averages are: Special Fifth, 10, Special Sixth, 10.5; by the Ayres scale: Special Fifth, 48.6, Special Sixth, 50.8. These scores are considerably below the medians reported by Freeman for 56 cities, but they are above Starch's standard and above the scores reported from Cleveland.* On the whole, the handwriting is certainly not of superior quality, but considering the fact that no instructions for good quality were given and that the samples were secured in October, it is not at all bad.

39. *Drawing a Church and a Snowball Fight.* The pupils in the Special Class were given 20 minutes to draw a church. On another day they were given 20 minutes to draw a snowball fight. Nineteen college students in the class previously mentioned ranked each set of drawings in order of merit. Later the same students graded the first set of drawings with the aid of the Thorndike drawing scale. In the latter case it appeared that the sixth grade did but little better than the fifth grade, and the best score was obtained by a fifth-grade pupil. The Thorndike scale presented numerous difficulties that could probably be overcome by rearrangement of its contents.

40. *Drawing a Horse.* The drawings of the church and of the snowball fight were useful in permitting the pupils to show their skill in composition (arrangement

*For these and other standards, see the *Seventeenth Yearbook, Part II*, just referred to, p. 88.

of details) and perspective, but on that account they made rating difficult. To secure a subject that would be familiar to all and present little chance for divergence in cleverness of composition (as distinct from good drawing), we asked each pupil on January 4, 1917, to draw a horse from memory. Five minutes was allowed, with a warning at the end of the third minute. The drawings from both Special and Control Groups were graded by four University students of education* with the aid of the Thorndike drawing scale.† The score given each pupil was the average of the ratings by these four students. The minimal, median, and maximal ratings are shown herewith. It is seen that there is no clear supe-

Drawing a Horse from Memory

	Min.	Med.	Max.		Min.	Med.	Max.
Special Fifth	2.20	5.93	11.18	Special Sixth	3.18	4.28	11.38
Control Fifth	2.00	5.68	9.28	Control Sixth	1.80	5.68	11.98

riority of either grade or of either group in drawing a horse.

41. *Drawing a Toy Wagon (from the object).* On the same date, January 4th, the pupils of both groups were allowed five minutes to draw from the object a small, two-wheeled, wooden toy wagon. The drawings were graded by the same persons and by the same methods as those of the horse. The results show that the drawings of the wagon tend to grade higher than those

Drawing a Wagon from the Object

	Min.	Med.	Max.		Min.	Med.	Max.
Special Fifth	4.13	6.78	9.60	Special Sixth	4.70	6.78	11.28
Control Fifth	1.60	6.33	11.35	Control Sixth	2.90	6.58	11.55

*Misses Harriett Berninger, Dora Keen, Frances Mapel and Margaret Doherty.

†This scale was the best available at the time. The difficulty is evident enough—to decide whether a given drawing of a horse was better or poorer than a drawing of a snow fort or a house or some other object. The material we accumulated might, I believe, be itself arranged now into a fairly good scale for drawing from memory. The idea would be to use it by having all the pupils tested draw a horse, within a five-minute limit.

of the horse, that in both grades the best drawing is by a member of the Control Group, but that, on the other hand, the lowest scores were made by members of the Control Group. The drawing supervisor of the Leal School states that there are five or six pupils in the Control Group whose skill in drawing is exceptional, but none in the Special Group. In the light of this the prevalence of a number of low scores in the Control Group and their lower averages in this test suggests that perhaps drawing the wagon demands a certain knowledge of perspective that drawing the horse does not and that children of inferior intelligence acquire this knowledge of perspective drawing slowly if at all. If this be true, possibly the drawing of the horse may be better fitted than the drawing of the wagon to unearth real differences in drawing talent, uncomplicated by training and informational modification.* In any event, there would seem to be no doubt that drawing is not a serviceable index of intelligence for the purpose of sifting gifted from average pupils.†

42. *Esthetic Appreciation Test (Thorndike-Manuel).* In further study of the talent for drawing in these pupils Dr. Manuel gave to the Special Group a test of esthetic appreciation which he arranged by modification of certain plans proposed by Thorndike.‡ There were presented five series of forms—two of rectangles, two of crosses, and one of ladder-like designs. The pupils were to mark the members of each series in order of attrac-

*Some with whom I have debated this point are of the impression that children who have a true natural talent for drawing see objects and draw them in perspective without any training.

†This is not to deny, of course, what we have said elsewhere in this report, that the attainment of the highest achievements in this field demand that the innate talent for drawing be supplemented by a good, if not a superior degree of general intelligence.

‡Tests of esthetic appreciation. *Jour of Educ. Psych.* 7: 1916, 509-522.

tiveness and were scored by amount of deviation from the order determined by competent judges of beauty of proportion. The results leave the investigator in doubt as to the reliability and usefulness of the test, even within its assigned province.

43. *Constant Increment Test.** A test that might be deemed an arithmetical test is that of adding 8 to a series of two-place numbers. This was given to our Special Group in December, 1916, but was not tried with the Control Group. The pupils were to write their additions against each number, continuing for 10 minutes and marking their place each minute as directed by the experimenter. The most striking results are the wide range of performance and the decided difference between the two Special Grades, as the tabular statement makes evident. Miss Coy, who conducted the test, questions whether it is of enough value for the time required to work up the results, even when the pupils correct the papers as the teacher reads off the correct sums.

Constant Increment Test

	Attempts			Rights		
	Poorest	Aver.	Best	Poorest	Aver.	Best
Special Fifth	68	102.3	146	66	99.0	145
Special Sixth	101	144.3	200	96	139.6	193

44. *Error-Checking Test (Thurstone).* This test had been used by its originator at the Carnegie Institute of Technology. In it the pupils were supplied with a printed sheet containing five long columns of simple arithmetical combinations (additions and subtractions) wherein some of the printed answers were wrong, *e. g.*, $11-7=4$; $2+13=16$. The pupils worked 4.5 minutes checking wrong answers only, and were scored 1 for each correct checking, minus 1 for each wrong checking.

*See R. S. Woodworth and F. L. Wells. Association tests. *Psychological Monographs*, No. 57, 1911.

We possess no data for comparison. The scores in terms of minimum, median and maximum were for the Special Fifth, 21, 28.5, 48; for the Special Sixth, 21, 37.7, 51.

45. *Practice Test in Multiplication.* On February 23, 1917, all groups were given Sheet 16 of Thompson's *Minimum Essentials* as an initial test in speed and accuracy of multiplying combinations that are not in usual tables (up to the 12's) and that have products less than 100. This sheet contains 162 examples, like $3 \times 13 =$, $15 \times 2 =$, etc. The time taken by each pupil to finish was recorded by stop-watch, in seconds, and was divided by per cent. of products correct, to give the final measure of efficiency.

From Monday, February 27th, to Friday, March 9th, that is, for 10 school days, the pupils (except in Control Class F) were practised with Sheet 15 for 10 minutes daily. (This sheet is similar to Sheet 16, but is printed on two sides and contains more combinations.) They then exchanged papers and corrected them by checking while the teachers read the proper answers. To maintain interest each pupil was told his score of the day before (in this case the score was the number of correct products written in 10 minutes).

On Monday, March 12th, all took the same test used at the start (that with Sheet 16) which was administered and scored as in the initial test.

We have, then, data for the Initial Test, the Practise Period and the Final Test (after 100 minutes' practise).

A study of the records of the initial and final tests in multiplication shows that the Special Group excels the Control Group in ability to profit by practise. There is little difference between the two groups when the test is started, but after the period of practise the superiority

of the Special Group becomes evident; in fact, two weeks of practise of 10 minutes a day have brought the Special Fifth up to the level of the Control Sixth. Two suggestions are obvious; first, a test of learning might be especially desirable in differentiating gifted from aver-

Scores in Multiplication Tests (Thompson's Sheet 16)
(Time in seconds divided by per cent. of correct products)

	Initial Test				Final Test		
	Poorest	Med.	Best		Poorest	Med.	Best
Special Fifth	13.5	10.50	7.3	Special Fifth	7.92	5.14	3.19
Control Fifth	18.0	10.15	5.0	Control Fifth	9.80	6.35	3.29
Special Sixth	8.9	7.00	4.2	Special Sixth	5.48	3.32	2.16
Control Sixth	16.0	7.35	4.5	Control Sixth	9.60	5.08	2.60

age pupils; second, the amount of drill needed by gifted pupils to attain a given proficiency is measurably less than that needed by average and dull pupils.

46. *Courtis Arithmetic Tests, Series A and B.* We gave these tests to the Special Group on six different days in October and in the following order: Series B, Form 2, Tests 1, 2, 3, 4; Series A, Form 3, Tests 2, 3, 5, 4, 6, 7, 1, 8. We followed the Courtis directions and time-limits* but modified the method of recording results in some respects to facilitate individual comparisons.

The results are presented in the form of class averages (here more significant than medians) for Series B, compared with a number of proposed standards.† It is evident that our Special Fifth ought to be compared with the fourth-grade and our Special Sixth with the fifth-grade standards. When this is done, our Special Fifth is found to be inferior to June standards for speed in the fourth grade, except in division. But our Special Sixth stands out very well. Save in addition, where it

*S. A. Courtis. *A Manual of Instructions for Giving and Scoring the Courtis Standard Tests.*

†These have been drawn from Monroe, DeVoss and Kelly, Table III, page 40.

Courtis Arithmetic Tests; Series B Speed (Attempts)

(October class average for the Special Classes compared with three June standards)

Grade	Special Class	Standards 1	2	3
Addition				
IV	—	7.4	6.0	8.0
V	6.47	8.6	8.0	9.0
VI	8.18	9.8	10.0	10.0
VII	—	10.9	11.0	11.0
Multiplication				
IV	—	6.2	6.0	6.0
V	5.5	7.5	8.0	7.0
VI	8.8	9.1	9.0	9.0
VII	—	10.2	10.0	10.0
Subtraction				
IV	—	7.4	7.0	7.0
V	6.5	9.0	9.0	9.0
VI	10.0	10.8	11.0	10.0
VII	—	11.6	12.0	11.0
Division				
IV	—	4.6	4.0	4.0
V	4.6	6.1	6.0	6.0
VI	9.5	8.2	8.0	8.0
VII	—	9.6	10.0	10.0

Standard 1 is based on median scores from many thousand individuals tested in May or June; Standard 2 is that proposed by Courtis on the basis of three years' use of the tests; Standard 3 is the median scores obtained in three years' use at Boston.

averages certainly no better than a fifth grade in June, it surpasses the fifth-grade standard, and it does remarkably finely in division (almost a seventh-grade June score).

In accuracy the scores of the Special Fifth are 40, 77, 64 and 83 per cent. and those of the Special Sixth are 62, 87, 76, and 93 per cent., respectively, for the four operations. Comparison with the 'General' medians of Courtis and the Boston standards for fourth grades in June shows that in accuracy the Special Fifth is very low in addition, somewhat low in subtraction, about normal in multiplication and remarkably good in division (83 vs. 57 or 60 per cent.). Similar comparison with the standards for fifth grades in June shows our Special Sixth to have been in October inferior in addition, above expectations in subtraction and multiplication and remarkably good in division. Since we unfortunately did not apply these tests to our Control Group, we have no way of knowing whether the selected pupils surpassed them or not. It would seem possible that the Leal School teachers had been neglecting drill in addition and over-

emphasizing drill in division. And it may be that the superiority of gifted children comes out more clearly in the more difficult process of division.

47. *Woody Arithmetic Tests, Series A.** These were given to the Special Group between November 7 and 14, 1916, and the directions laid down by the author were closely followed. Although many of our pupils finished before time was called, no credit was given them in the scoring, which was at first worked out precisely according to directions. The 'class-scores' thus obtained by

Scores in the Woody Arithmetic Tests, Series A

	Addition	Subtraction	Multiplication	Division
Special Fifth	8.18 (6)	6.91 (6.5)	6.87 (5.5)	6.14 (6.5)
Special Sixth	8.39 (6.5)	7.55 (8)	7.39 (7)	7.34 (8)

Woody's method may be interpreted approximately in terms of grades as indicated by the figures in the parentheses; that is, our Special Fifth grade is approximately equal to the expected performance of the sixth grade in addition, is half way between the sixth and the seventh grades in subtraction, etc. The scores of our Special Fifth in multiplication and division were lowered by the circumstances that they had just entered their work with fractions and had at the time done but little in multiplying and dividing fractions, so that they failed when they encountered these problems in the test blanks.

Two comments are in order here. In the first place, we have found that a simpler method of scoring (in terms of number of problems solved correctly) yields us information almost identical with the very complex and tedious method prescribed by Woody; we are sure the time expended in following his scoring directions can be better employed. This is true both for scoring

*Clifford Woody. *Measurements of Some Achievements in Arithmetic.* New York, 63 pp.

the work of the individual pupil and of the class as a whole.

In the second place, there is some discrepancy between these results and those already reported for the Courtis tests, according to which our Special Group was not far ahead of the standard performance in any operation save division and the poorest work was in addition. Here, one month later, our Group is from a half a year to two years advanced. Partly, the discrepancy is due to comparing tests made very soon after the summer vacation with tests made some six or seven weeks after instruction had been in progress. Perhaps it may be due in some further part to the differences between the two tests; the Courtis problems are longer than the Woody problems; a single error in the former nullifies perhaps a minute's work, in the latter perhaps the work of 15 or 20 seconds. Again, the fact that the Woody problems are graded in difficulty probably encourages the pupil. Finally, the discrepancy may be due in some part to rapid progress made by the pupils after their segregation into a smaller group where their short-comings could be noted.

48. *Woody-McCall Mixed Fundamentals, Series B, I and II.* These modifications* by McCall of Woody's Series B were given to the Special Group February 11 and 12, 1917, Sheet I one day and Sheet II the next. The papers were collected at the end of 20 minutes, and pupils were credited if they finished before then. The scoring followed the strict method indicated above, but supplementary scores were computed by dividing the time by the accuracy score—this in order to give some

*The modification compels the pupil to vary the kind of arithmetical operation to be used from problem to problem.

weight to speed of work. The same sheets were given to the Control Group about 10 days earlier. The average results are shown by groups for both sheets and for both methods of scoring.

Scores in Woody-McCall Arithmetic Tests, Series B, Sheet I

A. Average Number Done Correctly

Special Fifth	26.34	Special Sixth	28.60
Control Fifth	23.31	Control Sixth	24.10

B. Average Time per Correct Solution

Special Fifth	41.1	Special Sixth	31.7
Control Fifth	51.6	Control Sixth	46.0

Scores in Woody-McCall Arithmetic Tests, Series B, Sheet II

A. Average Number Done Correctly

Special Fifth	27.60	Special Sixth	29.26
Control Fifth	23.71	Control Sixth	26.59

B. Average Time per Correct Solution

Special Fifth	30.7	Special Sixth	23.8
Control Fifth	43.5	Control Sixth	35.6

The results show clearly enough the decided superiority of the Special Group; the Special Fifth exceeds the record of the Control Sixth in each comparison, especially if speed is also taken into account, and the detailed distributions of individual scores bear out the superiority. In a way, of course, this is no more than would be expected; our pupils were selected partly for their records in the school, and it is generally conceded that quality of work in arithmetic is the primary consideration in determining school standing in these grades of the elementary school.

49. *Reasoning Tests, I and II (Bonser).* These two tests were given to the Special Group February 22, 1917, and to Rooms G, F, and Y of the Control Group on February 22, March 1, and March 13, respectively. They comprise simple problems in arithmetic in which stress is laid in scoring upon correctness of method and there is no penalty for inaccuracy of figures. Following Bonser's directions to stop all pupils when the first one finishes, we obtained from the Special Group the following

time-limits, which were used later with the Control Group:

	Fifth Grade	*Sixth Grade*
Test I A	108 sec.	108 sec.
Test I B	94	82
Test II A	107	73
Test II B	64	64

It will be noted that while a few pupils in our Special Group made surprisingly poor records, the Group as a whole is distinctly better than the Control Group; in fact, the Special Sixth does more than twice as well as its Control Group, and the Special Fifth even runs ahead of this Control Sixth. Because Bonser fails to give the time-limits on which his scores are computed, we cannot compare our results with his; presumably our time-limits were shorter. We may note that our best record is within one point of the perfect score, 40.

Scores in Bonser Reasoning Tests I and II

	Poorest	Median	Best		Poorest	Median	Best
Special Fifth	4	14.50	30	Special Sixth	8	22.50	39
Control Fifth	0	6.70	25	Control Sixth	0	10.15	24

50. *Thorndike Reading Scale A: Visual Vocabulary.* This test was given to the Special Group October 17th and to the Control Group three months later, so that these circumstances distinctly favored the Control Group. We used a method of scoring more complicated than that proposed by the author* and obtained thereby a better differentiation of the pupils. The lines on the test-form are numbered from 4 to 10.5 to indicate the relative difficulty of the words in each. By giving to each word the value thus indicated, complete failure would mean 330.5 errors. We computed the per cent. of accuracy in relation to this maximum of inaccuracy, multiplied by 100, and divided by the time in seconds

*E. L. Thorndike. The measurement of ability in reading. *Teachers College Record*, 15: Sept., 1914.

needed to complete the test. The results coincide remarkably well with those obtained with the Binet vocabulary test: the sixth grade does distinctly better than

Thorndike Reading Scale A

		Poorest	Aver.	Best			Poorest	Aver.	Best
Special	Fifth	41	89.3	204.4	Special	Sixth	78	158.5	354.4
Control	Fifth	26	75.3	141.0	Control	Sixth	26	106.7	286.0

the fifth grade and our Special Group does distinctly better than the Control Group, despite the three months' advantage of the latter.

51. *New York Ventilation Commission Vocabulary Test.* This material was prepared by W. A. McCall and was intended to comprise a series of words equal in difficulty to the Thorndike scale just discussed. Actually, it turns out to be much more difficult. We gave it to both our Special and our Control Group in March, 1917. Because a number of poorer pupils made fast records by giving up the attempt to mark the words in the last three lines, we have found it better to grade this test simply in terms of correct responses, using the credit values assigned by the deviser of the test to each set of words. The maximal possible score is 352.5 points: the actual obtained scores are here indicated. The Special

New York Ventilation Commission Vocabulary Test

		Poorest	Aver.	Best			Poorest	Aver.	Best
Special	Fifth	95	153.9	224.5	Special	Sixth	115	200.6	282.0
Control	Sixth	29	112.8	249.0	Control	Sixth	73	157.2	306.5

Group is found to be almost exactly a year ahead of the Control Group in the abilities demanded by this test.

52. *Thorndike Reading Scale Alpha.* This was given to the Special Group October 18, 1916, and to Room G of the Control Group, January 25th, 1917. For reasons beyond our control we were unable to give this scale to the rest of the Control Group and regard our work

with it as mainly preliminary to the giving of the Alpha 2 Scale. We may note, however, that as with the Thorndike Reading Scale A (Test 50), we obtained better differentiation by scoring after a different plan than that proposed by the author of the scale.* We found that it was desirable also to record and utilize the speed of performance. When this is done, the average for the Special Sixth is considerably better than that of the Special Fifth, whereas, by the Thorndike method of figuring class scores, the Special Fifth surpasses the Special Sixth, 8.5 vs. 6.78. The inference is, then, that the Special Fifth is as capable as the Special Sixth of reading a passage and getting the correct ideas from it, but that it is not able to do this in so short a time. Comparison with data published by Thorndike show that our Special Fifth was much better than his fifth grades, but that our Special Sixth was only slightly better than his sixth grades.

53. *Thorndike Scale Alpha 2, Part II, for the Understanding of Sentences.*† This was given to the Special Group February 23, 1917, and to Rooms F, Y, and G of the Control Group earlier in that month. The time of completion was marked on the papers. All of the Special Group finished within the 30 minutes allowed. Because we tried, however, to combine certain data from Scale Alpha we gave over the utilization of the time records. Since our data for Steps 4, 5.25, and 6 were too inaccurate, our final measure of ability was based on Steps 7 to 9. The number of right responses for each step is multiplied by the value of the step, and the sum

*E. L. Thorndike. The measurement of ability in reading. *Teachers College Record*, 15: Sept., 1914.

†E. L. Thorndike. An improved scale for measuring ability in reading. *Teachers College Record*, November, 1915, and January, 1916.

of these products for Steps 7 to 9 affords the figure here used to measure each pupil's ability.

On this basis the Special Sixth is virtually identical with the Special Fifth, 102 and 101. If the class scores are computed according to the method prescribed by Thorndike, the relation is reversed, as the Special Fifth scores 7.25 and the Special Sixth scores 7.14, which indicates, once more, that the former grade was as capable as the latter in reading a passage and getting the correct ideas from it. Our Control Groups may also be compared with the tentative scores set by Thorndike and with those just cited for our Special Groups, as follows:

Grade Five:	Thorndike 5.75	Our Control 5.96	Our Special 7.25
Grade Six:	Thorndike 6.50	Our Control 6.43	Our Special 7.14
Grade Seven:	Thorndike 7.00		
Grade Eight:	Thorndike 7.50		

It may be noted that our selected pupils are, on the average, better than 7th-grade expectations; probably by the end of the year they would reach 8th-grade standards. The test, then, should be of service in differentiating bright pupils.

54. *Punctuation Test.* In March, 1917, the Total Group took a punctuation test of the following sort.*

"Insert capital letters and the proper punctuation marks so as to indicate the sentences in the following passages.

"What a cozy little room this is the moment I opened the door I fell in love with the place do you see the great open fire-place at the end of the room it will hold a four-foot log on the panel above it you see the motto of good cheer on each side is a many-paned window and a glimpse of the garden the windows just now are framed in brilliant red leaves of woodbine is there anything so homelike as books and a fire here are all kinds of books ranged in cases on each side of the room what treasures for a rainy day now I will pull out a chair before the fire and snuggle down in luxury with a story book."

No time-limit was set; on the contrary, quality was urged and hurry discouraged. Most of the pupils finished in two to three minutes; all in seven

*This test was one of a number of 'unclassified' forms examined by Miss Coy at Teachers College, Columbia University. We do not know who devised it or whether it has been described in print.

minutes. The score was one point for each punctuation or capital letter correctly placed, with no deduction for incorrect ones. Perfect score is 20. Reference to the tabular summary will show that the Special Group runs

Scores in Punctuation Test

	Poorest	Median	Best		Poorest	Median	Best
Special Fifth	4	14.75	19	Special Sixth	2	14.75	19
Control Fifth	0	12.10	19	Control Sixth	2	11.92	19

about 3 points better than the Control Group, but that no differences appear between the 5th and the 6th grades. Three of the Control Fifth who scored 18 or 19 were among those selected as qualified for the Special Group; Pupil No. 24, who made the low score in the Special Sixth, was slated by other mental tests for failure; omitting him, the poorest score for the Special Sixth would have been 9 instead of 2. If we take all these items into account, the punctuation test is a pretty fair index of school intelligence.

55. *Winch Composition Test.* On October 31, 1916, the pupils of the Special Group were given a sheet of paper containing the words of the first list used by Winch* and on November 3, 1916, the words of the second list, with the instructions for writing a composition as specified by him. The pupils took from 20 to 90 minutes for each composition. Later, these compositions were typewritten (to avoid impressions from handwriting that might affect judgment of composition) and given to seventeen students of a college class in educational measurement, who graded them on the basis of the Thorndike-Hillegas Extension of the Hillegas Scale for the Measurement of English Composition.

*See the writer's *Manual of Mental and Physical Tests*, Part II, p. 269, Test 46.

Scores in the Winch Composition Test

	First Composition			Second Composition		
	Poorest	Aver.	Best	Poorest	Aver.	Best
Special Fifth	27.7	38.0	47.6	28.4	39.4	49.1
Special Sixth	33.7	47.8	63.0	28.6	44.1	62.5

By combining the scores of the two compositions and then comparing these scores with the standards computed by us in terms of percentiles (see next chapter), we find that in October the average score in the Special Fifth almost reaches the median score to be expected of fifth grades in June (43d instead of 50th percentile), while that of the Special Sixth is better than the median score to be expected of sixth grades in June (54th instead of 50th percentile). The composition work of one pupil in the Sixth (No. 19) was graded as equal to the average performance of students at the end of the sophomore year in the high school, *i. e.*, about five years advanced!

Chapter V

INDIVIDUAL DIFFERENCES IN THE MENTALITY OF PUPILS IN THE SPECIAL GROUP

In the preceding chapters the mental and educational tests have been explained and their outcomes reviewed, one by one, from the standpoint of the tests themselves. These outcomes brought out individual differences of a more or less striking character. It was demonstrated, for instance, that some of the children in the Control Group were superior in mental and in pedagogical ability to some of those in the Special Group; it is equally true, though perhaps not so clearly demonstrated in what has been said thus far, that some of the children that had been selected for the Special Group were relatively inferior in mental and pedagogical ability and ought to have been left in the Control Group. Similarly, our various tests have clearly revealed inequalities within the mental equipment of individual children; one may surpass the others in memorizing, but be himself surpassed in reasoning; one may excel in arithmetic, another in drawing, etc.

Now, in this investigation we are interested in the mentality of the individual pupils under observation as much as we are interested in the mental and educational tests that were applied to them. We perceived early in the investigation the desirability of bringing together for each child all the facts that we could assemble (at least from classroom investigation) that would throw light upon his 'giftedness.' This chapter describes the method by which these records of individual pupils were made up. The majority of the data was that obtained directly from the mental and educational tests: to these

Percentile Tables for the Fifth Grade

	Test No.	No. of Cases	High	90	80	70	60	50	40	30	20	10	Low
Binet I. Q.	1	—	?	116	110	106.8	103	100	97	94	91	85	?
Woody Arith. A—Addition	47	690	35.0	29.0	26.9	25.3	24.0	23.1	22.0	21.1	19.9	18.4	5.0
Woody Arith. A—Subtract.	47	680	31.0	24.4	23.1	22.0	21.2	20.5	19.7	18.7	17.6	15.9	0
Woody Arith. A—Multip.	47	690	30.0	24.1	22.0	20.4	19.4	18.3	17.4	16.1	14.4	11.8	0
Woody Arith. A—Division	47	680	31.0	22.3	20.6	19.3	17.9	16.5	14.9	14.1	12.7	10.8	0
Woody-McCall Arith. B I.	48	60	30.0	28.6	26.8	26.0	25.5	25.0	24.4	23.6	22.1	19.8	14.0
Woody-McCall Arith. B II.	48	70	31.0	29.6	28.2	26.9	26.1	25.3	24.6	24.0	22.9	18.8	13.0
Bonser Reasoning I & II.	49	60	30.0	18.8	15.3	11.8	9.3	7.8	6.3	4.6	3.1	1.4	0
Ayres' Spelling—List V.	37	—	96.0	66.2	59.2	52.8	47.3	42.0	36.7	31.2	24.8	15.8	(—12.)
Thorndike Visual Vocab.	50	70	204.4	128.5	104.0	90.2	78.5	64.6	60.4	52.9	43.6	36.6	26.2
Ventilation Com. Vocab.	51	70	70.7	52.5	44.1	40.3	36.4	33.4	29.5	25.3	22.9	18.5	8.2
Thorndike Scale Alpha.	52	70	141.7	114.8	99.1	85.6	80.4	72.5	65.4	58.1	50.2	41.6	14.0
Trabue Tests B & C.	21	60	33.0	29.3	27.3	25.9	25.2	23.8	23.2	22.4	21.3	17.8	12.0
Trabue Tests J & K.	22	70	20.0	15.5	13.9	12.6	11.4	10.4	9.6	8.8	8.2	6.5	2.0
Word Building	18	60	33.0	28.3	25.8	23.6	21.9	20.1	17.6	16.1	14.2	12.4	2.0
Composition (Winch)	55	—	6.0	4.97	4.64	4.40	4.20	4.00	3.80	3.60	3.36	3.03	2.00
Punctuation	54	60	19.0	18.1	16.5	14.7	13.4	12.6	11.5	9.8	6.8	4.5	0
Handwriting	38	—	81.0	67.0	59.0	51.5	47.0	43.0	40.0	36.0	32.0	25.5	11.6
Drawing—Wagon	41	60	11.4	8.4	7.6	7.15	6.8	6.5	6.25	5.75	4.65	3.35	1.6
Drawing—Horse	40	60	11.2	7.7	7.1	6.5	6.1	5.8	5.5	5.05	3.7	3.2	2.0
Steacy Drawing Con. 1-40	34	60	18.23	27.75	34.1	37.3	41.3	43.5	47.5	57.5	63.5	77.8	143.0
Steacy Drawing Con. 41-100	35	60	.588	.860	1.101	1.224	1.362	1.426	1.717	1.888	2.493	4.450	60.00
Thurstone Hand Test.	30	60	25.0	19.0	7.5	3.3	+.14	−3.3	−7.5	−14.5	−18.3	−23.3	−29.0
Thurstone Flag Test.	33	70	21.0	17.8	14.5	7.5	+2.1	−1.17	−3.75	−7.3	−15.4	−21.4	−30.0
Thurstone Spatial Relations.	31	70	15.0	29.6	37.6	60.0	82.0	112.6	130.3	176.5	274.0	1002.0	1010.0
Thurstone Punched Holes.	32	70	34.0	12.3	7.8	6.4	5.5	4.8	4.3	3.6	2.9	1.6	0
Memory—Lincoln & Pig.	12	70	34.0	28.8	27.1	26.1	23.9	22.8	21.8	20.5	19.4	17.8	13.0
Deferred Memory—Lincoln.	12	60	29	25.5	22.5	20.1	19.4	17.9	16.8	16.3	15.4	13.3	9.0
Memory—Marble Statue.	12	60	48.0	40.3	37.8	35.8	33.8	30.5	29.3	27.8	25.6	22.3	17.0
Equivalent Proverbs.	26	60	40.5	67.0	79.0	117.5	131.0	153.7	158.8	191.7	225.0	295.0	400.0
Bonser Reasoning III, V, VI	27	60	91.0	61.8	52.5	44.5	39.2	34.9	30.7	26.9	19.0	12.5	5.0
Thurstone Reasoning.	29	70	10.0	5.4	4.1	2.1	+.81	−.83	−2.0	−4.7	−6.2	−12.3	−22.0
Completion of No. Series (Coy)	24	70	31.0	17.5	11.3	10.4	7.7	6.4	5.5	1.9	0	0	0
Multiplication—Initial.	45	50	5.0	7.35	8.33	8.63	9.13	10.15	10.73	11.55	12.05	13.45	18.0
Multiplication—Final.	45	40	3.20	4.45	4.68	5.08	5.65	6.03	6.45	7.65	8.95	9.25	9.8

Percentile Tables for the Sixth Grade

	Test No.	No. Cases	High	90	80	70	60	50	40	30	20	10	Low
Binet I. Q.	1	—	?	116	110	106.8	103	100	97	94	91	85	?
Woody Arith. A—Addition	47	630	38.0	35.6	34.1	32.8	31.2	29.8	28.3	26.6	24.8	22.7	16.0
Woody Arith. A—Subtract.	47	660	35.0	31.6	29.3	27.6	26.0	25.1	24.1	23.1	21.9	20.1	4.0
Woody Arith. A—Multip.	47	660	37.0	33.0	30.9	29.3	27.7	26.2	24.6	23.1	19.4	18.0	1.0
Woody Arith. A—Division	47	670	36.0	30.4	28.2	26.7	25.2	23.7	22.2	20.7	19.0	16.3	4.0
Woody-McCall Arith. B I.	48	70	33.0	31.5	30.2	29.1	28.4	27.6	26.6	25.3	24.2	23.1	17.0
Woody-McCall Arith. B II.	48	70	33.0	32.3	31.3	30.3	28.6	27.8	27.1	26.1	24.6	23.2	21.0
Bonser Reasoning I & II.	49	70	39.0	24.3	20.5	16.8	13.6	10.5	9.1	6.2	4.1	2.3	0
Ayres' Spelling—List V.	37	—	(112.)	82.2	75.2	68.8	63.3	58.0	52.7	47.2	40.8	31.8	4.0
Thorndike Visual Vocab.	50	70	354.5	193.5	159.3	134.8	118.5	107.4	97.9	87.4	77.1	62.3	28.9
Ventilation Com. Vocab.	51	70	87.1	67.5	59.1	54.1	50.5	45.5	41.1	38.5	35.8	30.5	20.7
Thorndike Scale Alpha	52	70	149.0	128.5	115.5	107.9	94.1	82.3	74.8	71.3	59.1	47.3	21.0
Trabue Tests B & C	21	70	36.0	30.1	28.0	27.4	26.5	24.8	23.4	22.3	21.3	19.8	16.0
Trabue Tests J & K	22	70	21.0	16.8	16.2	13.6	12.6	11.4	10.4	9.6	8.8	7.5	2.0
Word Building	18	70	37.0	30.3	28.1	25.9	24.8	22.8	20.4	18.8	16.6	14.4	9.0
Composition (Winch)	55	—	6.5	5.47	5.14	4.90	4.70	4.50	4.30	4.10	3.86	3.53	2.50
Punctuation	54	70	19.0	17.7	16.1	14.9	13.6	12.2	11.1	9.6	7.6	4.5	2.0
Handwriting	38	—	90 (?)	76.13	67.10	60.8	56.6	52.7	48.8	44.9	41.0	34.7	20 (?)
Drawing—Wagon	41	70	11.55	9.3	8.45	7.85	7.2	6.7	6.25	5.85	5.6	4.55	2.90
Drawing—Horse	40	70	11.93	8.75	8.05	7.00	6.45	5.60	4.8	4.1	3.5	3.1	1.85
Steacy Drawing Con. 1-40	34	70	14.5	23.5	28.6	31.1	33.1	35.2	38.5	42.3	46.5	57.8	165.0
Steacy Drawing Con. 41-100	35	70	.655	.825	.901	1.082	1.163	1.229	1.335	1.472	1.634	2.306	15.00
Thurstone Hand Test	30	80	46.0	16.8	13.2	7.9	4.4	+1.2	−2.3	−6.7	−17.0	−21.8	−44.0
Thurstone Flag Test	33	70	21.0	21.0	15.8	12.2	+9.5	+5.3	+1.5	−2.1	−5.8	−12.8	−27.0
Thurstone Spatial Relations	31	70	13.7	26.0	88.4	45.0	54.0	76.5	95.8	115.2	187.4	900.7	1010.0
Thurstone Punched Holes	32	80	36.0	16.8	9.2	6.9	6.2	5.4	4.6	3.7	2.9	.93	0
Memory—Lincoln & Pig	12	80	34.0	29.8	27.8	26.7	25.8	24.3	23.1	21.7	20.3	18.9	10.0
Deferred Memory—Lincoln	12	70	29.0	25.8	23.1	22.2	20.8	18.6	17.6	16.6	15.1	13.8	10.0
Memory—Marble Statue	12	70	51.0	41.2	39.3	36.3	34.4	32.9	31.6	29.2	27.4	23.8	18.0
Equivalent Proverbs	26	70	39.6	51.7	69.0	83.7	100.8	112.5	128.3	150.0	185.0	270.0	580.0
Bonser Reasoning III, V, VI	27	70	95.0	76.6	58.9	53.8	47.9	44.9	37.5	29.4	24.4	21.2	13.0
Thurstone Reasoning	29	70	10.0	6.8	5.2	3.9	3.0	+2.1	+.81	−.72	−3.2	−8.2	−12.0
Completion of No. Series (Coy)	24	70	31.0	25.5	21.5	18.2	14.1	10.9	9.3	7.4	6.3	5.3	0
Multiplication—Initial	45	60	4.2	5.15	5.75	6.28	6.95	7.58	8.05	8.75	9.48	10.85	16.0
Multiplication—Final	45	40	2.2	2.95	3.28	3.39	3.83	4.05	4.38	5.53	6.15	7.83	9.6

Explanation of Percentile Scores

No.	Name	Score Used in Percentile Tables
47.	Woody Arithmetic Test—Add.	Number of problems solved correctly in 20 min.
47.	Woody Arith. Test-Subtraction	Number of problems solved correctly in 20 min.
47.	Woody Arith. Test-Multiplication	Number of problems solved correctly in 20 min.
47.	Woody Arith. Test-Division	Number of problems solved correctly in 20 min.
48.	Woody-McCall Arith. B-I	Number of problems solved correctly in 20 min.
48.	Woody-McCall Arith. B-II	Number of problems solved correctly in 20 min.
49.	Bonser Reasoning I and II	Credit of 2 for each correct solution
37.	Ayres Spelling List V	Per cent. of list spelled correctly
50.	Thorndike Visual Vocabulary	Per cent. of accuracy divided by the time
51.	N. Y. Ventilation Commission Vocabulary	Per cent. correct
52.	Thorndike Scale Alpha	
21.	Trabue Tests B and C	Sum of the scores for Steps 7 to 9
22.	Trabue Tests J and K	Sum of scores for B and C, by Trabue's method of scoring
		Sum of scores for J and K, by Trabue's method of scoring
18.	Word Building	Total number of words in 10 minutes
55.	Composition (Winch)	Grades by Thorndike-Hillegas Composition Scale
54.	Punctuation	Number of punctuation marks correctly placed
38.	Handwriting	Grades by Ayres Handwriting Scale
41.	Drawing—Wagon	Grades by Thorndike Drawing Scale
40.	Drawing—Horse	Grades by Thorndike Drawing Scale
34.	Steacy Drawing Construction 1-40	Time divided by the number correct
35.	Steacy Drawing Construction 41-100	Time divided by the number correct
30.	Thurstone Hand Test	
33.	Thurstone Flag Test	Rights minus twice the wrongs
31.	Thurstone Spatial Relations	Rights minus twice the wrongs
32.	Thurstone Punched Holes	Total time divided by number of rights
12.	Memory—Lincoln and Pig	Number of holes correctly placed
12.	Deferred Memory—Lincoln	Number of "ideas" remembered
12.	Memory—Marble Statue	Number of "ideas" remembered
26.	Equivalent Proverbs	Number of "ideas" remembered
27.	Bonser Reasoning III, V, VI	Total time for Sets I, II, and VI. divided by total number correct
29.	Thurstone Reasoning	Total score for 3 tests when scored by Bonser's method
24.	Completion of No. Series (Coy)	Rights minus twice the wrongs
45.	Multiplication—Initial	Scored by method described in text
45.	Multiplication—Final	Scored by total time divided by per cent. of accuracy
		Total time divided by per cent. of accuracy

data were added notes on the ambitions and ideals of the children and notes on certain non-intellectual traits not readily subjected to the objective tests.

A. SUMMARIZING FOR EACH PUPIL THE OUTCOMES OF THE TESTS

1. The Pupil's Record Card. For the purpose of summarizing the test results for each pupil we prepared a form of pupil's record card with spaces for entering for every one of our group tests, (*a*) the pupil's own score, (*b*) the maximal, (*c*) the minimal and (*d*) the median (or average) scores for his Special Class and for his grade generally and also (*e*) his percentile standing.

2. The Percentile Tables. A word of explanation is necessary to explain the way in which the percentile tables were obtained. They were derived from tables arranged for 34 tests for the fifth and for the sixth grade separately. In 27 of them the data were obtained by us directly in our group tests. Those for Woody's four arithmetic tests were obtained from the comprehensive results he publishes, while those for handwriting, English composition and spelling have been computed from meagre data supplied by other investigators and by rather elaborate processes of interpolation.* In general, we claim for these percentile tables merely an approximation for a group of unselected children of the

*Thus, our percentiles for handwriting were computed by taking results reported by C. H. Judd, *Measuring the Work of the Public Schools*, p. 70, and other data supplied by D. Starch, *Educational Measurements*, pp. 80-3. Those for English composition are derived from Trabue, Supplementing the Hillegas scale, *Teachers College Record*, January, 1917, by taking his figures for the medians and probable errors and working out the percentile curves on the assumption that the distribution is of the normal type. A similar method was used in working out percentiles for spelling on the basis of averages and the standard deviations given by L. P. Ayres in his *Measurement of Ability in Spelling*, pp. 24-34.

5th or 6th grade.* Most of these percentile distributions are based upon about 70 cases per distribution—not enough for statistical precision, but enough to be helpful to subsequent investigators. The amount of work that we have had to do in our attempt to reach these approximate percentiles where data were lacking, prompts us to urge every investigator who reports norms and averages for any test to supply some sort of indication of the detailed distribution of his data.

Finally, it hardly need be pointed out that the percentiles we have supplied are serviceable only to investigators who follow our methods of administering and scoring the tests in question.

3. Classification of the Tests. A certain difficulty of interpretation appeared when these individual record cards were examined, just because of the large number of tests that we had employed. To meet this difficulty it was evidently worth while to attempt a classification of the tests into groups that measure, so far as may be inferred, the same or similar abilities. A classification into the following groups was adopted: Binet I. Q., arithmetic, spelling, vocabulary, reading, language, composition, handwriting, drawing, spatial relations, memory, reasoning, rapidity of learning.

4. 'Ability Profiles.' The next obvious step was to represent the standing of the individual pupil graphically, so that it might be comprehended almost at a glance, and this has brought us to a device analogous to the 'psychological profile' of Rossolimo. Across the top of the chart are arranged the 34 tests, grouped as just

*Unselected in the sense of including all the pupils in the fifth and sixth grades in the Leal School: it is quite possible, in fact quite probable, that the presence of the neighboring university community has lifted these scores perceptibly above those to be expected by random selection of fifth and sixth-grade pupils.

explained. Running vertically along the left-hand margin are the various percentiles from 0 to 100, while the median performance, 50th percentile, is shown by a heavy horizontal line across the middle of the chart. One thing needs further explanation. The distance vertically from the 50th to the 60th percentile is made much less than the distance between the 90th and 100th percentile—indeed, this last distance is the same as that from the 50th to the 90th percentile. The idea is to indicate visually the fact that in actual ability the 60th person is relatively much more like the 50th than the 100th person is like the 90th, or, in other words, that the step from the position of 90th to the position of 100th in a rank-order of 100 persons is far larger (in terms of performance) than is the step from the position of 50th to the position of 60th in the same rank-order.*

In our sample chart reference to the graph for Pupil No. 1 will show how the plan is worked out. This girl is above the 99th percentile in Binet I. Q., 138; she reaches the 98th percentile in the Woody addition test, the 99th in the Woody subtraction test, and so on. Note that this gifted girl makes the highest score of any child in the entire fifth grade in 7 of the 34 tests here listed, that she reaches or exceeds the record of 90 pupils per 100 in 20 of the 34 tests and that in only one test, initial speed in multiplication, did she even fall as low as the median 5th-grade child.

On the same chart there is shown for comparison the results obtained from Pupil No. 4. Note that though a member of our Special Fifth, he reaches the 100th per-

*The adjustment involves the supposition that the surfaces of distribution for these 34 tests are of the 'normal' type, and is then a simple matter of translating percentiles into terms of standard deviation. The distances from the median to the percentiles 60, 70, 80, 90, 96, 99, and 100 are approximately in the ratio 1, 2, 3, 5, 6, 8 and 10, respectively.

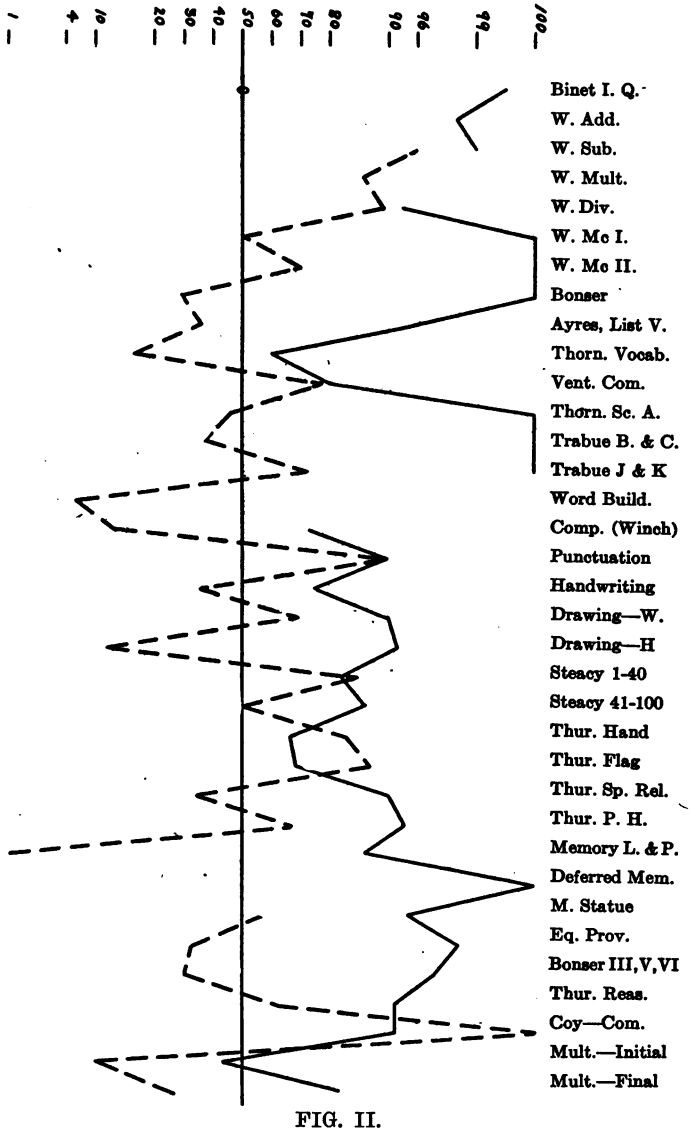

FIG. II.

Percentiles Obtained by Pupil 1 (solid line) and Pupil 4 (broken line) of the Special Fifth.

centile, *i. e.*, leads the Total Fifth, in but one test, that he attains the 90th percentile in but 5 tests, falls below the 75th in 23 tests, below the median in 16 tests (virtually half of them) and below the 25th in 5 tests. This record accords neatly with his Binet I. Q., 101.5. Note that he exceeds our Pupil No. 1 in ability to deal with spatial relations, which has only a low correspondence, on the whole, with general intelligence.

5. Report for Parents and Teachers. Now these record cards and charts are excellent for those who have had some training in statistics or mental tests, but they have considerably less usefulness for many teachers and most parents. On this account, we next prepared for each child a much simplified and condensed record of his work and abilities. There is shown herewith a bona-fide sample of this *Report of Educational and Psychological Tests.** In filling out this record, the data for the number of children in a 100 (or 1000) who would reach a given I. Q. were taken from Terman,† as was also the characterization of each I. Q. as 'average,' 'superior,' 'very superior,' etc. The "Results of Tests" that follow are grouped under 13 rubrics, with the first—arithmetic—divided to show separately, ability in computation and ability in arithmetical reasoning. Reasoning concerning non-arithmetical situations was given a place by itself, and experience showed that it would have been better to have subdivided this again into "Reasoning with Concrete Material" and "Reasoning with Abstract Material." Similarly, experience showed that it would have been better to have subdivided the heading just

*The plan of this mimeographed "Report" form is made evident here by printing in italics all the portions of it that were filled in with the pen for each pupil separately.

†*The Measurement of Intelligence*, pp. 78-79.

*REPORT OF EDUCATIONAL AND PSYCHOLOGICAL TESTS**

NAME *Burrows, Dorothy* GRADE *5 D* INTELLIGENCE QUOTIENT *138.* In *October, 1916, her* chronological age was *10* yr. *1* mo. *Her* mental age was *13* yr. *11* mo.. The I. Q. is therefore *138.0. One* child in *250* has an I. Q. as *high* as *138.* General intelligence is *therefore very superior.* In mental age *she* ranks *3d* in present class of *15;* in I. Q. *she* ranks *3d in class.*

RESULTS OF TESTS

Subject	Rank in class of fifteen	Rank in 100 children	Remarks
Arithmetic: Computation	*2*	*4*	*Remarkably good in computation. Is very accurate and is also rapid.*
Arithmetic: Reasoning	*1*	*1*	*Arithmetical reasoning is of the very highest quality—probably about that of an 8th-grade pupil.*
Spelling	*3*	*6*	*Excellent*
Vocabulary	*7*	*25*	*Has a 13-yr.-old vocabulary. (25 is probably too low)*
Understanding of passage read	*1*	*1*	*Very superior*
General language ability	*1*	*1*	*Very superior*
Composition	*4*	*10*	*At beginning of 5th grade, did work which was average for end of 6th grade*
Handwriting	*3*	*25*	
Drawing	*2*	*3*	*Excellent*
Esthetic appreciation	*5.5*		
Spatial relations and forms	*5*	*20 (or better)*	*Very good*
Reasoning	*1.5*	*3*	*Very superior. Ability to see more or less abstract relationships is remarkable.*
Speed of learning	*5*	*Very high; perhaps 10*	*Very rapid improvement*
Memory	*2*	*5*	*Rote memory is about that of a 17-year-old. Logical memory remarkably good*

Summary and Conclusions:

General intelligence is remarkably high. She makes first-class records in all subjects. Least high records in vocabulary, handwriting and spatial relations.

Has very superior ability in reasoning. Will certainly do good work in any form of mathematics. Language ability is also very remarkable. She wants to be a poet, an artist or "just a housewife."

Is probably the best student in the 5th grade—results are more consistently excellent than those of the others.

*The italicized portions of the report are the ones written in for each child.

before that into two headings—"Spatial Relations" and "Ability to Use Forms."

The "Rank in the Class of 15" is figured from the top, so that No. 1 is the best and 15 the poorest in each grade of the Special Group; the "Rank in 100 Children" means rank-order in an unselected group of the child's school grade; here the number is, of course, the reverse of the child's percentile score, *e. g.*, if the percentile score were 90, the rank would be 10th.

In deciding the rank to accord a pupil under each of the headings, several tests were usually taken into account, *e. g.*, six tests were used to estimate ability in arithmetical computation. This grouping of the tests for purposes of practical condensation and simplified reporting followed the arrangement here depicted, but it must be explained that we did not always use the average or median score obtained by the child in a given group of tests to represent his status in that group; sometimes, when the results were discordant, we used our judgment in deciding which test ought to be given the greatest weight. On this account we claim nothing more than an approximation in the figures; nevertheless, they do serve excellently to report general tendencies in the child's lay-out of capacities and are probably considerably more precise and certainly much more meaningful than the usual run of school marks.

The final section of this "Report" for teachers and parents—"Summary and Conclusions"—is self-explanatory. Miss Coy, who prepared these summaries, tried to state clearly the ability, both general and particular, of the child, to show his weak points and to make recommendations for future training. Here also was introduced in many instances a statement of the child's ambitions and their relations to his ability.

Grouping of the Tests for Ranking Pupils under Various Subjects in the "Report of Educational and Psychological Tests"

1. Arithmetical computation	Woody, Series A, and Woody-McCall arithmetic tests I and II
2. Arithmetical reasoning	Bonser reasoning tests I and II Analogies*
3. Spelling	Ayres spelling List V and in part also Lists N and R
4. Vocabulary	Binet vocabulary Thorndike vocabulary Ventilation Commission vocabulary
5. Understanding of passage read	Thorndike scale alpha for understanding passage read
6. General language ability	Trabue tests B, C, J, K Completion tests 3 and 4
7. Composition	Winch composition test
8. Handwriting	Samples scored by Ayres scale
9. Drawing	Drawing of wagon and horse Steacy drawing construction 41-100 In part church and snowfight drawings
10. Esthetic appreciation	Thorndike esthetic appreciation test
11. Spatial relations and forms	Thurstone flag test Thurstone hand test Thurstone spatial relations A Form boards
12. Reasoning	Equivalent proverbs I, II, VI Bonser reasoning III, V, VI In part painted cube (Doll), Whipple picture arrangement and Thurstone reasoning tests
13. Speed of learning	Multiplication practise Pyle marble-sorting test In part Thurstone substitution and symbol-digit substitution
14. Memory	Whipple's three tests of logical memory, immediate and deferred recall

B. THE AMBITIONS AND IDEALS OF INDIVIDUAL PUPILS IN THE SPECIAL GROUP

The pupils in the Special Group were asked on June 4, 1917, to write out and hand to Miss Coy statements of what they wanted to do when they grew up. The results are, I think, of sufficient interest to warrant their inclusion in this report.

*The analogies test was placed here because it had afforded such close correlations with liking for mathematics and school grades in algebra in the Urbana High School. I think now this is still defensible, but, nevertheless, it would be better to consider analogies as a test of ability to grasp abstract verbal relationships. It could be placed in Group 6 or Group 12.

What the Children in the Special Group Wish to do When They 'Grow Up'
(June 4, 1917)

1. A poet (just a rhyme-maker), an artist, or just a housewife.
2. A writer. "I like to write stories."
3. Mother of a large family, or an actress.
6. An artist. Likes to draw plants and flowers.
7. A dressmaker or a bookkeeper.
8. A farmer.
9. A stenographer.
10. An artist.
11. A stenographer or music teacher.
12. Carpenter or mechanic.
13. A singer, "like Galli-Curci."
14. A banker or a farmer.
15. To travel to National Parks of U. S. and to foreign countries, to teach music or drawing.
16. Soldier, or sailor, or mounted policeman.
17. League baseball pitcher, motorcycle racer, pole vaulter, wrestler, and be an "honest man."
18. A musician. In university wants to take music, foreign language.
19. An author. Probably teach school while learning to write.
20. A farmer.
21. An actress or a nurse
22. An auto mechanic, a farmer, or a carpenter.
23. A piano soloist. Expects to graduate from university at 21 years, then marry and go on with piano work.
24. A railroad engineer.
25. Teacher of piano.
26. Electrical engineer. Is going to be "a great inventor."
27. An artist. Wants to marry and paint her husband and children.
28. A teacher or a Red Cross nurse.
29. An acrobat in a circus.
30. A soldier—"not a general or hero, but just a common soldier."

A perusal of this summary of ambitions ought to convince the reader, even though he be unacquainted with the children or their performance in the several tests, that in the main few of the pupils want to do things for which they lack ability. The tendency, on the contrary, is to report ambitions that seem distinctly too low. Thus, No. 11, who wishes to be a stenographer, has an I. Q. of 141; No. 12, who wishes to be a carpenter or mechanic, has high scores in reasoning and in esthetic judgment; No. 30, who wishes to be "just a common soldier," has an I. Q. of 133 and is remarkably gifted along several lines. It is not too much to declare, I think, on the basis of this very simple trial, that efforts to improve and to guide the education of pupils of superior mental endowment ought to include a study of the ambitions

and ideals of these pupils and a systematic effort to foster and develop ambitions commensurate with the latent capacities revealed by objective testing.

C. INDIVIDUAL DIFFERENCES IN NON-INTELLECTUAL TRAITS

An attempt was made to analyze and record impressions of certain traits of a predominantly non-intellectual sort. For this purpose Dr. Manuel drew up a record sheet in which 31 traits were listed.* The main feature was a device for recording the estimated amount of each trait by marking a point somewhere along a horizontal line, (three and a half inches long), which was assumed to stretch from the lowest degree of the trait (left end of the line) through average (center of the line) to the highest degree of the trait (right end of the line). The first few lines of the record-sheet (directions and first two traits only) will illustrate the idea.

Score Sheet: Character Schedule

Name.....
Place a mark across each horizontal line to show the amount or degree of the quality possessed by this child

1. Very low spirited .....Very cheerful
2. Moods very permanent .....Very rapidly changing moods.

The complete list of traits was grouped as follows:

Emotions

1. Cheerfulness
2. Permanence of mood
3. Tendency toward extreme depression
4. Readiness to become angry
5. Readiness to recover from anger
6. Occasional liability to extreme anger
7. Degree of esthetic feeling
8. Degree of sense of humor
9. Degree of excitability (vs. phlegmatic tendency)

Self Qualities

10. Desire to excel in competition
11. Desire to impose his will on others (tolerance vs. intolerance)
12. Self confidence

*These were taken, with modifications, from E. Webb, Character and Intelligence. *Mon. Brit. J. Psych.*, 1915.

13. Self esteem
14. Fondness for large social gatherings
15. Fondness for small circle of intimate friends
16. Tendency to do kindnesses on principle
17. Degree of corporate spirit
18. Conscientiousness
19. Readiness to accept the views of others (vs. independence)
20. Desire to be liked by associates
21. Degree of tact in getting on with people

Activity

22. Amount of time given to mental work (studying)
23. Amount of bodily activity (restlessness) while at work
24. Amount of energy thrown into games and sports
25. Amount of foresight (working for distant ends) displayed
26. Tendency to persist at tasks in face of obstacles
27. Tendency to persist in face of the monotony of long application

Intelligence

28. Quickness of apprehension
29. Profoundness of apprehension (seeing relationships between ideas)
30. Soundness of common sense (practicality of judgment)
31. Originality of ideas (fertility and resourcefulness in solving problems and meeting situations)

Each child in the Special Group was graded in these 31 traits by three judges, Dr. Henry, Miss Coy and the classroom teacher. These judges had before them not only this character schedule, but also another typewritten set of 'Explanations' wherein each of the 31 traits was described in more detail than was feasible on the record-sheet. For example, Trait No. 3 is thus elaborated:

"Occasional liability to extreme depression. Eager to fasten on a grievance, real or imaginary, and make the most of it. Liability to occasional moods during which everything looks black. Having occasions during which the individual takes a dejected view of life."

The results are on file in the writer's office, but reasons beyond our control have prevented us from working them over for this report. We content ourselves with describing the method and listing the traits in the hope that these may be helpful to other investigators and perhaps to parents and teachers.

Chapter VI

RELATION OF THE TEST RESULTS OF PUPILS IN THE SPECIAL GROUP TO OTHER INDEXES OF INTELLIGENCE

We have not attempted any elaborate study of the inter-correlations of our tests, tempting as that is, but have limited ourselves to working out certain methods that would summarize the performance of each child in the Special Group in the mental and educational tests and that could be used for comparison with other measures or indications of intelligence.

A. The median test percentile

One of these methods dealt with the obtaining of a summary of the child's rank in the 34 tests for which we were able to calculate percentile distributions. It was obtained by taking the median of his station in them and may be termed the "median test percentile." It ought certainly to give a fairly precise indication of the general level of mental ability of each child.

In the accompanying table this median test percentile is compared with the results of the Binet testing and with the rank in intelligence as estimated by the class teacher.

The Binet testing has already been sufficiently clearly explained. Readers will understand that it yields two values with which comparison may be instituted—the absolute mental age and the relative mental age, or I. Q.

Median Test Percentile of Each Pupil in the Special Fifth and Special Sixth, Together With Rank in Intelligence Quotient, Mental Age and Teacher's Estimate

Pupil	Median Test Percentile	Rank in Median Test Percentile	Rank in I. Q.	Rank in Mental Age	Rank by Teacher June, 1917
1	91.5	1	3	3	1
2	83.5	3	1	1	3
3	77.5	5	10	13	10
4	47.5	14	15	14	14
5	58.0	13	13	12	13
6	75.0	8	5	6	5
7	66.5	10	8	10	11
8	59.5	12	6	7	12
9	77.0	6	12	8	8
10	70.5	9	11	11	7
11	79.5	4	2	2	2
12	76.0	7	7	4.5	9
13	42.5	15	14	15	15
14	60.0	11	4	4.5	4
15	90.8	2	9	9	6
35	90.5	—	—	—	—
16	76.0	6	1.5	4	7
17	68.0	7.5	5	2	2
18	66.5	9	12	11.5	14
19	87.5	2	4	3	3
20	68.0	7.5	14	14	11
21	57.0	11	13	5	9
22	51.5	12	11	9.5	8
23	89.0	15	3	7	13
24	50.0	13	15	15	12
25	79.5	4	10	11.5	6
26	59.0	10	6	8	10
27	82.5	3	8	6	4
28	78.5	5	7	9.5	5
29	40.5	14	9	13	15
30	91.5	1	1.5	1	1
34	88.4	—	—	—	—

B. THE TEACHER'S ESTIMATES OF INTELLIGENCE

The estimate of intelligence by the teacher of the Special Group was undertaken with all the precautions, and following rather closely the directions, suggested by Stern.* The 30 cards containing the names of the pupils were arranged by her in order of estimated general intelligence on November 7, 1916, again on December 16, 1916, and finally on June 6, 1917. In making these rank-orders the teacher did not refer to the pupils' school

*L. W. Stern. *Psychological Methods of Testing Intelligence*, Baltimore, pp. 116-127.

marks, but, though instructed to estimate in terms of general intelligence, it is probable that the estimate was somewhat colored at least by the performance of the children as pupils in the classroom. The results show that the teacher's estimates differed a good deal on the three different occasions; by the Spearman footrule method of correlation, her ranking of the Special Fifth children shows correlations of from 76 to 84, but that of the Special Sixth children ranges from 56 to 70 only. In illustration, a pupil ranked 2d in the 6th-grade in November, was ranked 8th in December and 13th the following June.

C. CORRELATIONS OF VARIOUS CRITERIA OF INTELLIGENCE

The correlations between these several measures of intelligence for each grade are shown herewith. There must of necessity be high correlations, it will be understood, between mental age and I. Q., since the latter is based upon the former. Where the chronological ages of the children are closely similar, in the 5th grade, the correlation is very high, .96, and where the chronological ages are more varied, in the 6th grade, the correlation falls to .74. Of the several correlations, special interest

Correlations of Various Criteria of Intelligence

	Median Test Percentile		Teacher's Estimate		Intelligence Quotient	
Grade	V	VI	V	VI	V	VI
Teacher's Estimate	.84	.82				
Intelligence Quotient	.56	.84	.84	.41		
Mental Age	.64	.42	.84	.69	.96	.74

attaches to those between the teacher's estimate of intelligence in June, after a year's familiarity with the pupils, and the summary for the series of 34 mental tests (median test percentile); this correlation reaches .84 with the 5th and .82 with the 6th grade (probable errors

about 0.11), which, it will be noted, is as high as, or higher than, the correlations which obtained among the November, December, and June estimates made by the teacher. If we assume that the estimate of the class teacher after a year's acquaintance with the 30 pupils represents their real order of ability, then the 34 tests (which could have been administered in a total of 17 hours during the first few weeks of the year) would have been as nearly correct in their ranking of the intelligence of the Special-Fifth pupils as was the teacher in November, 1916 (both correlations .84) and far more nearly correct in their ranking of the Special-Sixth pupils than was the teacher in November (the tests correlating .82 and the teacher's November estimate .56 with her June, 1917, estimates).

Other correlations to which interest attaches are those that show that the teacher's estimate of intelligence is more closely related to mental age than it is to the intelligence quotient. The fact is, of course, that our selected class really was not very homogenous; it represented both too wide a range of mental ages and also too wide a range of chronological ages. Any observer is likely to give too much credit to the chronologically more mature child and too little credit to the chronologically less mature child, not remembering that for the latter to do equally good work in the same school grade with the former is really a demonstration of greater ability. This error probably affected this teacher's estimate of her pupils' intelligence.

D. RELATION OF THE TEST RESULTS TO SCHOOL ACHIEVEMENT

About February 1, 1917, all the pupils in the Special Group had completed the work ordinarily covered in one

school year. By June, 1917, both grades had covered another year's work, with the exception of the work in history, in which, for various reasons, some of them beyond our control, they lacked about three or four months' work. During the first week of June, 1917, the children of the Special Group were given a set of final examinations in the 6th-grade and 7th-grade subjects, with the understanding that, if they made satisfactory grades in these examinations, they would be permitted to enter the grade ahead by making up the history work during the summer or during the following year.

The results of these examinations should have a special significance for comparison with our predictions from the mental and educational tests that we had made more or less continuously through the year. Just how significant they are, we shall leave to the judgment of the reader when the details shall have been unfolded.

Counting No. 35 (the girl with the extraordinary I.Q. of 167, who was transferred to the Special Fifth from one of the Control Fifths at our request), nine of the Special Fifth were promoted to the seventh grade in June, 1917; and eight of the Special Sixth were at the same time promoted to the eighth grade. These promotions were made by the superintendent of schools on the basis of final examinations.

It is of peculiar interest now to see which pupils failed to secure promotion in June, and whether these are the failures that would have been predicted by our tests.

No. 4 was absent from the examinations. He plans to take them in September, 1917, and to study up for

them during the summer. Our test results would indicate that his success would be problematic.*

No. 34 was absent and will take the examinations in September, 1917. He should have not the slightest difficulty.

No. 15 left Urbana, March 1, 1917, for Pittsburgh.

There remain 12 cases that demand scrutiny.

In the fifth grade Nos. 3, 5, 9, and 13 and in the sixth grade Nos. 16, 18, 21 and 26 failed in arithmetic; they are allowed to take 'make-up' examinations in September, 1917, and to be promoted then if successful.* Some portion of these June failures, I feel certain, may be ascribed to the method of grading the examination papers. It is the custom for the 5th-grade and 6th-grade teachers in the Leal School to give half-credit for a solution whose method is correct but whose computation is wrong, and I understand that all promotions have been based on this method of grading papers. The papers for our Special Group, however, were graded by the superintendent, who gave no credit for problems worked by the right method but with incorrect answers (unless possibly when there was only a slight clerical error).

We have no official right, of course, to question the decisions of the superintendent of schools. He felt, we understand, that the pupils of the Special Class were prone to inaccuracy and that that fault must be eradicated, and secondly, he felt that if a child were to qualify to do two years' work in one, he ought not only to do faster work but also a better grade of work than pupils who are permitted to progress through the grades at the

*In September, Nos. 3, 4, 5, 13, 16, 21, 26, and 34 passed examinations for promotion. No. 18 moved out of town.

normal pace. He also apparently felt that his one, unstandardized final examination was a better index of ability in arithmetic than the results of the Courtis, Woody, Wood-McCall, error checking, and multiplication tests that we used during the year, supplemented by daily observation of the class work of the children.

In any event, there are four cases in which the superintendent's decision as to promotion in June was, in our opinion, wrong. Nos. 3, 16, and 26 have been shown conclusively by our many tests to be capable in arithmetic: of these Nos. 16 and 26 reason very well in arithmetic—they are *above* the average of the *Special* Group in this respect—but both of them are likely to be inaccurate in their figuring; presumably, had their ability been tested by ordinary examinations, scored on the same basis as used for ordinary pupils of these grades, their promotions would not have been held up.

On the other hand, No. 24 was promoted, greatly to our surprise. His I. Q. is just under 100, the lowest in the Special Sixth; his mental age is the lowest in the Special Sixth; in the 34 tests he ranks 13th, in the teacher's estimate of intelligence he ranks 12th in his group of 15 (see the table earlier in this chapter showing his median test percentile, etc.). He certainly has no more ability than an average sixth-grade child. Our summary for this boy runs: "Compared with general sixth-grade standards, he is about average in general language ability, composition, handwriting, drawing, general reasoning ability and memory; he is considerably above average in spelling, size of vocabulary and computation; he is far below average in arithmetical reasoning, understanding of passages read and handling of spatial relations." He is also conspicuously steady in his work. We

surmise that either the examination was not difficult with respect to arithmetical reasoning or that this boy happened to hit on the right methods; his good ability, steadiness and accuracy in arithmetical computation then carried him through where the cleverer but less accurate failed.

The failing of Nos. 5, 13, 18 and probably that of No. 21 in the arithmetic examination is justified by the results of the mental tests during the year.

In the same way we might show that in the language examination the failing of Nos. 8, 18 and 22 and probably that of Nos. 20 and 29 seems justified, and the failing of No. 26 not justified, by all that we discovered by mental and educational tests during the year.

Another method of checking up the results of our mental tests in terms of school performance is to reverse the procedure and predict from the tests what should have happened in the classroom. We have worked this out by starting at the lower end and eliminating different numbers of pupils in various ways. For instance, if we assume that a class of gifted children ought at least not to include in its enrollment any pupils poorer than the top 20 per cent. of the ordinary school population, and if we assume that the Stanford Revision of the Binet is the criterion of mental ability,* we would rule out all pupils with an I. Q. under 110; that would have removed six from our Special Fifth and five from our Special Sixth, and those thus removed would have been children whose outcome in the final examination was as indicated in the accompanying table.

*I am indebted to my colleague, Dr. Ruml, for statistical demonstration that the Stanford Revision is superior to the Goddard-Edition Binet or the Yerkes-Bridges Scale for the purpose of selecting the upper 20 per cent.

School Success of Pupils in the Special Class Whose Intelligence Quotient was Less than 110

Grade	Pupil	I. Q.	Rank by I. Q. within Special Grade	Outcome of Final Examinations for Two Years' Work in One
	4	101.5	15	Absent; would anticipate failure
Special	18	101.6	14	Failed in arithmetic
Fifth	5	107.0	13	Failed in arithmetic
	9	108.2	12	Failed in arithmetic
	10	109.3	11	Passed
	3	109.7	10	Failed in arithmetic
Special	24	99.3	15	Passed
Sixth	20	103.6	14	Failed in language
	21	107.0	13	Failed in arithmetic
	18	107.2	12	Failed in arithmetic and language
	22	108.0	11	Failed in language

In the same way we can discover which pupils would have been ruled out by the mental age criterion, by the teacher's June estimates of intelligence, by our median test percentile, etc. The operation of this last-mentioned criterion is shown here in tabular form.

School Success of Pupils in the Special Class Whose Median Test Percentile was Less than 60

Grade	Pupil	Median Test Percentile	Outcome of Final Examinations
	18	42.5	Failed in arithmetic
Special	4	47.5	Absent; would anticipate failure
Fifth	5	58.0	Failed in arithmetic
	8	59.5	Failed in language
	23	89.0	Passed
Special	29	40.5	Failed in language
Sixth	24	50.0	Passed
	22	51.5	Failed in language
	21	57.0	Failed in arithmetic
	26	59.0	Failed in arithmetic and language

Another criterion may be mentioned that is of more interest than the median test percentile, namely, the criterion afforded by a special combination of six only of the tests which is recommended in Chapter VIII for use in selecting pupils for gifted classes in these grades. These tests are the Woody-McCall Mixed Fundamentals I, Trabue Language Scales B and C, Bonser Reasoning Tests III, V and VI, Equivalent Proverbs VI, Thurstone Substitution Test and Thurstone Punched Holes Test.

One way of using these or similar combinations of tests for selective purposes is to determine empirically certain 'critical scores' for each test below which the test is arbitrarily said to be 'failed.' Selection may then be conditioned upon having 'passed' a given number of the tests. In illustration, the lower critical scores in the six tests have been taken as follows:

Test	Failing Scores for Admission to Special Fifth Grade	Special Sixth Grade
Woody-McCall	45 or more seconds	35 or more seconds
Trabue	25 or fewer points	26 or fewer points
Bonser	38 or fewer points	45 or fewer points
Proverbs	250 or more seconds	175 or more seconds
Substitution	95 or fewer letters	132 or fewer letters
Punched Holes	4 or fewer 'holes'	6 or fewer holes

It has then been assumed that pupils who fail in four, five or six of these six tests should not be admitted to a special class for the gifted and that pupils who fail in three of them should not be admitted unless individual examination (as by the Stanford Revision of the Binet tests) should reveal an I. Q. of 110 or above. When these criteria are applied to the Special Classes in the Leal School, the outcome is as shown in the accompanying table. Here there need be no comment in the cases of Nos. 4, 13, 20 and 29, because the critical score criterion agrees with the (relatively) low I. Q. and the fail-

School Success of Pupils in the Special Class who Fail to Reach the Critical Lower Score in Three or More of the Six Tests Recommended for Use in Selecting Gifted Pupils

Grade	Pupil	Number Tests Failed	I. Q.	Outcome of Final Examinations
	4	5	101.5	Absent; would anticipate failure
Special	8	4	122.7	Failed in language
Fifth	13	5	101.6	Failed in arithmetic
	14	3	130.9	Passed
	18	3	107.2	Failed in language and arithmetic
	20	5	103.6	Failed in language
Special	21	3	107.0	Failed in arithmetic
Sixth	24	3	99.3	Passed
	28	3	115.3	Passed
	29	4	110.6	Failed in language

ure to accomplish two years' work in one. The remaining cases deserve individual comment.

No. 8 would have been rejected forthwith by the critical score criterion that we have proposed and he failed in language; on the other hand, he secured on the Binet tests an I. Q. of 122.7, which would rank him in the top five per cent. In his "Report of Educational and Psychological Tests" his mental and educational status is summarized thus:

"His I. Q. of 122.7 is probably somewhat high. His work in the Binet was marked by exceeding variability; many of his successes in the higher years are due to ability to deal with objects in space, as in the clock test, the enclosed boxes, etc.

"His work is in general below the average of the Special Fifth, probably in the lower third of it. His poorest work is in spelling, composition, handwriting, drawing and memory, the last being particularly poor. His best work is in arithmetic, both in reasoning and in computation, and in other work dealing with concrete objects. He seems to have remarkable ability to visualize objects or at least to image in motor terms how they will behave when moved about in space.

"He is nervous and excitable, works rapidly and makes many mistakes. Has difficulty in going to sleep. Needs to be trained to self-control, to use tools and to play outdoors. He likes to work with tools and wants to be a farmer.

"In childhood he had an imaginary companion and later on a whole group of them, 13 or 14 in number, who to the boy were almost like members of the family."

From these comments I think it might be fairly inferred that it is at least questionable whether this boy should have been placed in the Special Group.

No. 14, by the method we are advocating, would have been classed as 'doubtful' by the critical score criterion, but would have been placed in the class on the strength of his high I. Q. (131), which is about the degree of intelligence reached by one child in a hundred. He passed the final examinations. Let us see whether our summary of his work explains this apparent inconsistency.

"John is about average, when compared with the other selected children, in arithmetical reasoning, spelling, understanding of passages read, composition, drawing, general reasoning ability and speed of learning. He is below the average in general language ability and logical memory. But on the whole, since he excels the average in range of vocabulary and esthetic appreciation, he may be classed as just about average. Compared with

general fifth-grade standards, he ranks above average, of course, in practically everything.

"A striking feature of his work is its deliberateness. He undoubtedly suffers in many speed tests on this account.

"He wants to be a banker or farmer."

From this summary it will be evident that this boy's failing in three of the six tests probably springs from his deliberate method of work and that the reference of his case to the individual examination would have compensated for this handicap and placed him in the Special Group where he was able to do satisfactory work.

No. 18, if handled by the method now under discussion, would have been classed as 'doubtful' by the group tests, would have been given individual examination and rejected on account of her I. Q. (107) falling below 110. She actually did fail in language and in arithmetic. Without quoting from her report sheet in detail, it may be stated that she is there described as very good in mechanical learning but extremely poor in reasoning, in which she falls below the sixth-grade average. Her work in arithmetical tests shows her to be a rapid, somewhat inaccurate worker with very low capacity to reason arithmetically. Here, then, the tests function accurately in indicating her rejection.

No. 21 who failed in arithmetic, is a girl much like No. 18, but somewhat nervous and erratic in her work. Her best achievement is in literary and linguistic directions; in fact, she seems to have real ability there. In arithmetic she is just about average for the sixth grade. She would have been rejected by the test method, and properly, in view of her relatively inferior school work outside of language studies.

No. 24 is a boy who would have been classed as 'doubtful' by the group tests and then rejected for his low I. Q.—99.3. The anomaly in his case arises from

the fact that he passed the June examinations successfully. Our summary describes this boy as an "average sixth-grade pupil who certainly ought not to have been placed in the Special Sixth." He excels the sixth-grade average at large in spelling, vocabulary and accuracy of computation, although he is slow at that; in everything else he is simply mediocre. There is no obvious way to explain his success in passing the examinations, which surprised us all, including his teacher (she had estimated him as 12th in his group of 15 in respect to general intelligence).

Finally, No. 28 failed in three of the six tests, but has an I. Q. of 115 and passed the examinations. Her case is, therefore, straight-forward. She is considerably above the average of the sixth grade in almost all respects. She shows, however, deficiencies in two directions: her records are relatively poor in tests dealing with more concrete materials and she seems somewhat peculiar in her manner (she gives the impression of being old for her years; she does not play much with other children; her emotional life seems not entirely normal).

In summary, then, of the eight pupils who, on the basis of our proposed system of selection by tests, would not have been admitted to the Special Class, six (Nos. 8, 13, 18, 20, 21 and 29) failed to pass the June examinations satisfactorily; one (No. 4) was absent but was reasonably sure to have failed; one (No. 24) passed the examinations to the surprise of those who had watched his daily work. Or, reversing the statement, of the 12 pupils selected for the class by the teachers, principal and superintendent in September who by the superintendent's June examinations were subsequently failed in either one or two subjects, six (Nos. 8, 13, 18, 20, 21, 29)

would have been rejected at the outset by our mental tests, and three of the remaining six (Nos. 3, 16, 26) were wrongly failed, as can be abundantly proved by our numerous objective measurements of their ability and their classroom performance.

I believe that this constitutes a conclusive demonstration that, while truly gifted children can accomplish the work of the 5th and 6th or of the 6th and 7th grades in one year, the selection of the 'gifted' must be made on a basis of performance in mental tests; because selection by teachers, on the basis of classroom impressions and school marks, will result in the inclusion of pupils who are unfit to attempt the work.

Chapter VII

INDIVIDUAL DIFFERENCES IN THE MENTALITY OF PUPILS IN THE CONTROL GROUP

A. 'GIFTED' CHILDREN IN THE CONTROL GROUP

It has been shown that within the Special Group, selected by the school officials for their presumptive school ability, were some eight or ten pupils that failed to accomplish the two years' work in one year in a perfectly satisfactory manner and that these pupils, with perhaps minor exceptions, would have been rejected at the outset, had the selection been made upon a basis of mental tests.

Our argument in favor of the superiority of the test method is, however, incomplete unless we can show that there were pupils left in the Control Group who would have succeeded splendidly in the Special Group and that these pupils would have been chosen at the outset, had the selection been made upon a basis of mental tests.

Our method of demonstrating this argument is as follows: when group tests were given to both the Special Group and the Control Group, a few pupils in the latter usually made better records than the average of the former group or even than the best record of the former group. We drew up a list of the pupils who most often furnished these better records, using 17 of our group tests to supply the data. Not to enter into details, inspection of this list indicated that certain pupils in the Control Group might be expected, according to mental tests, to be as good as the standard we set for a class of 'gifted' children. Without mentioning these pupils

by name, we then asked the teachers of the Control Group, now that they knew better the type of work demanded in a room for gifted children, to specify the pupils in their charge who were doing the best work and who might conceivably have been chosen to join the Special Group.

The amount of correspondence between our selection by means of mental tests and the teachers' selection by classroom observation is clearly indicated in the accompanying tabular summary, in which we have tried to indicate also in a concise manner certain instructive comments. We feel that inspection of individual records like these is worth while, particularly in those few cases in which the mental tests and the teachers' judgments show discrepancy.

Note first that, had membership in the class of gifted children been determined in the fall of 1916 by mental tests, six pupils that remained in the Control Fifth and eight pupils that remained in the Control Sixth would have been chosen as gifted pupils; note secondly that the teachers of the Control Group, on being asked to select, on the basis of daily observation of the classroom work in the fifth and sixth grades, those pupils who might have done successful work in the Special Class, *named of their own accord five of the six selected by mental tests for the fifth and seven of the eight selected by mental tests for the sixth grade.*

Let it be added that four of these children are known to have an I. Q. over 120 and that it is reasonably certain that eight more have an I. Q. over 115. Five of them really had been considered by the teachers previously for inclusion in the Special Group. Four of them, it is to be noted, chanced not to have been in the

Summary of Facts about 'Gifted' Pupils in the Control Group

Grade	Pupil	Gifted by Tests	Gifted by Teacher	Comments
5	F2	No	Yes	Tests indicated 'good,' but not brilliant
5	F6	Yes	No	Poor in arithmetic; fine otherwise. Has I. Q. of 121
5	F11	Yes	Yes	Does fine work. Parents would not permit to join Special Class.
5	F12	Yes	Yes	No reason known why not in Special Class
5	Y10	Yes	Yes	Previous schooling outside Urbana, hence no basis available to school.
5	Y11	Yes	Yes	Considered for Special Class; no reason known why not put there.
5	Y21	No	Yes	Test record only 'good'
5	Y25	No	Yes	Test record only 'good'
5	Y29	No	Yes	Test record only 'good'
5	Y35	Yes	Yes	Best pupil in room. Kept in Control Group because never in school before, hence no record. On basis extraordinary test record (I. Q. 167) transferred to Special Fifth, March 1, passed 6th-grade final examinations in June.
6	F16	No	Yes	Test records only 'fair.'
6	F19	No	Yes	Test records only 'fair.'
6	F21	No	Yes	Regarded as doubtful case by teacher
6	F20	Yes	Yes	Considered for Special Class; no reason known why not put there.
6	F34	Yes	Yes	Kept in Control Group because had been in Urbana schools only short time and record felt too brief. On basis high test records (I. Q. 135), transferred to Special Sixth March 1; did fine work; "always has lesson; never seems to study." Passed 7th-grade examinations.
6	G3	Yes	No-Yes	Fine test record; teacher deemed her 'average' until convinced wrong.*
6	G14	No	Yes	Record in tests not good.
6	G21	Yes	No	Tests above average of Special Sixth in 10 to 16 tests.
6	G23	Yes	Yes	Offered chance to enter Special Sixth, but wanted to remain with Teacher G.
6	G27	Yes	Yes	Does good work. No reason known why not chosen for Special Sixth.
6	G35	Yes	Yes	Ought to be in Special Sixth. Kept out on account low mark in geography; later found this mark due to absence from an examination!
6	G38	Yes	Yes	Work ranges average to extra good. No reason assigned why not chosen for Special Sixth.

*This girl ranked above the average of the Special Sixth in 7 of 16 tests—not perhaps a very brilliant record, yet her I. Q., 130, is very high, while she excelled every child in the Special Group in three of four 'reasoning' tests. This record was reported to the teacher with the intimation that it could hardly be felt to agree with his verdict of 'average' ability. After careful observation he was perfectly convinced that the girl had superior ability and merely needed to have her timidity overcome and to be made to take a more active and responsible part in classroom work. By the end of the term she was, in fact, making a much better showing in her school work and her teacher was agreed that she probably could have done successful work in the Special Sixth. I think this is worth relating as an illustration of the usefulness of mental tests in correcting teachers' impressions of children who happen not to reveal in their daily work the capacities they really possess.

Leal School before or for only a part of a year and on that account lost their chance of being chosen to join the gifted class. This number may be larger than would be expected ordinarily, but it indicates, in any event, one more way in which mental tests surpass school records for the classification of pupils.

Since, in the preceding chapter, it was shown conclusively that at least eight of the 30 pupils in the Special Group should have been left in the Control Group, and since it has now been shown that at least 12 of the pupils left in the Control Group had an excellent claim (proved by tests and approved by the teachers) to inclusion in the original Special Group, it is, I think, demonstrated conclusively that a judicious combination of mental tests that could have been administered to the Total Group in a relatively short time (say two hours) would have selected the membership of the Special Group in a manner unquestionably more satisfactory than the mode of selection actually adopted—reference to school marks and teachers' opinions. If the waste of time and energy in both directions—the teaching of the 8 wrongly included and the failure to facilitate the school progress of the 12 wrongly excluded—could be capitalized in dollars and cents, does any one doubt that it would pay for the cost of applying the mental tests?

B. 'AVERAGE' AND 'DULL' CHILDREN IN THE CONTROL GROUP

Our problem may next be extended and our argument confirmed in this wise: if teachers show a certain degree of unreliability in selecting 'gifted' pupils, will they show a similar unreliability in selecting 'average' or 'dull' pupils, or is it only in detecting the superior minds

that mental tests are needed as correctives of the school's estimate?

Each of the three teachers of the Control Group was asked to select two pupils she would regard as of 'average' and two she would regard as of 'dull' mentality. With the addition of a thirteenth case, recorded as poor in arithmetic and average otherwise, the group thus selected for us was given not only all the group tests that were given to the Special and the Control Group, but also nearly all the individual tests that were given to the Special Group. In consequence, we had for this 'baker's dozen' of pupils, opportunity for elaborate mental analyses, for the preparation of individual record cards, for the construction of percentile graphs—in short, the same opportunity for study as with the 30 pupils in the gifted class.

In this condensed report of our work the analyses of these pupils must be omitted. Let us consider only certain general results. Of the six pupils regarded by their teachers as 'dull,' one is rather slow but probably not really dull (I. Q. 94); five are quite assuredly dull and two of these, indeed, are presumptively feeble-minded! The I. Q.'s for these five are 78.4, 77, 72.5, 67.5 and 63.9. Of the six pupils regarded by their teachers as 'average' (omitting the 13th case with an I. Q. of 91.5),* the average I. Q. is 112.9, or about the degree of intelligence attained by 15 children in 100!† Three of the supposedly

*An interesting type of case exhibiting very poor ability to see relationships or to reason to a conclusion if in abstract terms, but rather good ability to think about concrete objects.

†This result may perhaps be somewhat affected by a wrong impression of 'average' ability gained by teachers who have taught for several years in a school attended by a number of children from the University community. We have not enough data to show whether the average intelligence in the Leal School really would rise above the average of other school populations as measured by mental tests.

'average' children do test average by the Stanford Revision of the Binet-Simon Scale (98.4, 100.7 and 104.2), but the other three are good enough to qualify for our class of gifted children (I. Q's 119, 125.2, and 130, respectively); of these, the first is already pedagogically a year advanced for her age and this had not been discounted by the teacher, who regards her as average; the second needs to be studied in detail before an explanation can be offered;* the third is the No. G3 already described in a footnote, p. 96.

From these results we think it may be inferred that pupils classed by their teachers as 'dull' are not very likely to be found on test to be average or superior. On the other hand, pupils classed by their teachers as 'average' may quite well be of superior intelligence, while, as we have already shown in our previous sections, pupils classed by their teachers as 'gifted' may quite well be of only average intelligence. May we not say, then, that *if psychological clinics or mental examiners are needed for selecting dull and stupid children, as most persons agree, then a fortiori they are an essential prerequisite for selecting gifted children?*

*Another interesting bit of material for 'case-study.' This boy is 11 years, 3 months, old with a mental age of 14 years, 1 month. In individual tests he is quite superior, but his records in group tests are only average. His movements are slow, and he seems to be confused by the speed limits in group tests. It is possible also that he fails to do his best save under the urge of direct personal contact. He is slow in speech, yet uncommonly quick in reasoning to correct conclusions. He shows good practical judgment, is self-possessed, and is competent in manual arts. His teacher, however, declares his school work shows nothing above average.

Chapter VIII

CHOICE OF TESTS FOR SELECTING GIFTED PUPILS

A. Method of making the choice

It might be possible to figure the correlation between the score attained in most of our mental and educational tests and the school grade or other indication of school performance attained by all the pupils under observation. The method we have adopted, however, is to compare the outcome of the tests in the Special Classes with that in the Control Classes of like school grade. The argument is: tests in which the average or median performance of the Special Classes exceeds decidedly that of the corresponding Control Classes are the best, other things (like ease of administration, of preparing equivalent material, of scoring, etc.) being equal. A comparison of this sort is probably more satisfactory, where the object is to select tests that shall divide a group of pupils into two groups, than the figuring of coefficients of correlation—however precise these might be arithmetically.

The reader needs, perhaps, to be reminded at the outset that we make this comparison under conditions unfavorable to the mental tests, for this reason. We have already demonstrated that in our Special Group there are some eight or ten pupils that should have been left in the Control Group and that there are in the Control Group some eight or ten pupils that should have been placed in the Special Group. Strictly speaking, then, it would be legitimate to reconstitute the two

groups before testing the diagnostic value of our various tests; we have not done this, partly because the improvement in our results would hardly repay the expenditure of time and energy, partly because we can tell by inspection of individual tests whether the gifted pupils in the Control Group surpass the average pupils mistakenly placed in our Special Group, partly because hypercritical readers might say that we altered the membership of our groups to suit our test results and then demonstrated a correspondence between the two!

In making the comparison between the average performance of the Special Group with the average performance of the Control Group, the question arose; how may the various tests be brought to a common denominator? Comparison in terms of 'points' or 'units' of scoring is out of the question, since a unit in one test is coarser than a unit in another. Similarly, comparison in terms of percentiles confronts the difficulty that the stretch from one percentile to another means different amounts of achievement in different portions of the range of scores. We have, accordingly, transferred the percentile distributions into terms of multiples of the standard deviation by methods already described in this report and have drawn various graphs in which the degree to which the average of the Special Group deviates from the average of the Control Group in each of 27 tests is thus translated into actual distances—inches and fractions of inches. By direct measurement of these graphs we are able to compare one test with another in units of efficiency in separating the Special from the Control Groups.

Several comparisons are possible. We should most naturally compare the tests with one another in efficien-

cy in separating the Special Fifth from the Control Fifth and Special Sixth from the Control Sixth. It is also instructive to see how they separate the Special Fifth from the Control Sixth (since it is proposed to have most of the pupils in the special Fifth make a double promotion and thus work in the same classroom as the Control Sixth.)

We have instituted still another basis of comparison, and it needs a few words of explanation. The Control Groups contain a number of children who do such poor work that they ought really to be in some lower school grade; these children do not constitute typical 5th- or 6th-grade material; their presence lowers the average score of the Control Classes and augments unnaturally the difference between their standing and that of the Special Classes. To our way of thinking, this objection has little or no weight, not at least unless we are permitted to take out of the Special Classes those that failed of double promotion. However, to load the dice against our tests and avoid any hint of favoring them, we have figured average (or median) scores for the Control Fifth and the Control Sixth after taking from them all children who were not promoted to the grade above in June, 1917, and we have contrasted these "Corrected Control Classes" with our uncorrected Special Classes.*

To return to the comparison of the tests with one another: we have measured the efficiency of the 27 tests that were given to all the groups in separating Special Fifth from Control Fifth, Special Sixth from Control Sixth, Special Fifth from Control Sixth, Special Fifth

*The change thus affected is curiously little. The median of the percentiles attained in 27 tests by the Special Fifth is 68.88, by the Control Fifth 41.25, by the Corrected Control Fifth 43.88; similarly, for the sixth grade the figures are 60.83, 39.77 and 45.50, respectively.

from Corrected Control Sixth, and we have ranked these 27 tests in order of merit for effecting each of these separations. Without stopping to present the array of numerical figures that have resulted, we summarize by saying that at least eight tests and probably a ninth can claim first-class rank in separating the Special Classes from the Control Classes: nine can be deemed of medium and nine of practically no value for this purpose.

VALUE OF VARIOUS GROUP TESTS FOR DISCOVERING GIFTED CHILDREN

A. Of High Value for Separating the Special from the Control Group
1. Thurstone Punched Holes
2. Trabue B and C
3. Trabue J and K
4. Woody-McCall Arithmetic I
5. Woody-McCall Arithmetic II
6. Steacy Drawing, 41-100
7. Equivalent Proverbs
8. Bonser Reasoning III, V and VI
9. Whipple Lincoln (deferred recall)

B. Of Medium Value for Separating the Special from the Control Group
10. Ventilation Commission Vocabulary
11. Thorndike Alpha for Understanding of Sentences
12. Final Multiplication Practice
13. Bonser Reasoning I and II
14. Whipple Marble Statue (immediate recall)
15. Thorndike Visual Vocabulary
16. Punctuation
17. Drawing a Wagon from Object
18. Thurstone Reasoning

C. Of No Value for Separating the Special from the Control Group
19. Steacy Drawing Construction, 1-40
20. Completion of Number Series
21. Thurstone Flag
22. Whipple Word Building
23. Whipple Lincoln (immediate recall)
24. Initial Multiplication Practise
25. Drawing Horse from Memory
26. Thurstone Hand
27. Thurstone Spatial Relations

Comments on this outcome will not be amiss. The most surprising outcome is the preeminent place accorded the Punched Holes test by every method of calculation. Dr. Thurstone classed it with his other spatial relations tests, but it appears to put a premium upon general intelligence. It will be of interest to know wheth-

er the test will serve a similarly useful purpose with pupils of other ages and grades.

The Trabue tests would be expected to show a good correlation with general intelligence, as completion tests in general have done in the past.

The Equivalent Proverbs and Bonser III, V and VI tests all stress ability to see relationships verbally expressed.

The Woody-McCall Mixed Fundamentals are tests of an educational activity—ability to compute—with the feature of compelling the selection of the right process for each problem: their place in our series is higher than we anticipated.

The Steacy Drawing Construction 41-100 is said by Steacy to be a good test of general intelligence; it appears to demand close observation, ability to reason about concrete things and ability to execute one's ideas with a pencil. The two highest scores in this test were pupils with I. Q.'s of 141 and 167.

Note that the only 'logical memory' test that was tried with all pupils for both immediate and deferred recall finds a place in the 'high value' group when scored for deferred recall, but is of no value when scored for immediate recall; also that Marble Statue (immediate recall) is in the 'medium value' group. One would infer, then, that the recall of the comparatively simple *Lincoln* story directly after hearing it, is relatively easy for all pupils of these grades; whereas the recall two weeks later is hard enough to 'tease out' the competent pupils. The somewhat more complex *Marble Statue* story is hard enough to be of medium value with immediate recall; it is unfortunate that we were unable to get data on its efficiency with deferred recall.

Similarly, the intial performance in the Multiplication Practise test does not separate the two groups, whereas in the final test the Special Classes are enough superior to give the test medium efficiency in separating the groups. From this we might infer that a brief test of improvement under practise ought to be included in a combination of tests for separating gifted pupils; unfortunately, we lack comparative data to determine whether the Thurstone substitution test would be serviceable in that manner.

Of the tests of no value for our purpose, several quite clearly test specialized forms of ability, *e. g.*, the Spatial Relation test, Flag test and Hand test of Thurstone and the Drawing from Memory. Some are too easy, *e. g.*, the Steacy Drawing, 1-40, the Immediate Memory for the *Lincoln* story, while it seems likely that the Completion of Number Series is too difficult for these grades. The low place accorded Word-Building agrees with my inability to discover correlations between it and the class standing of grammar-school pupils at Ithaca, N. Y.

Of the tests of medium merit for our purpose, five evidently test abilities in which the pupils in these grades are more or less similarly trained by the school, viz., the two Vocabulary tests, the Understanding of Passages Read, Punctuation and probably the Drawing of a Wagon. The Thurstone Reasoning test is surely much too hard for children of these grades.

In all this discussion, the reader will please bear in mind, we have been limiting ourselves to the merits of group tests, and to only those group tests that we happen to have applied to both Special Group and Control Group. In the presentation of the results of the tests themselves, we have intimated that several that are not

mentioned in our 27 above are doubtless worth further investigation. The point is emphasized further in the next chapter of this report *à propos* of the Winch Composition test. We have also called attention to the very useful results we obtained from several of our individual tests—notably, of course, the Binet tests, and also the Analogies, the Hard Opposites, the Painted Cube and others.

B. RECOMMENDED PROGRAM OF TESTS

Omitting individual tests of all sorts and omitting all reference to those of our group tests that were not applied to the Total Group, we recommend that pupils of the 5th and 6th grade be selected for inclusion in special classes for the gifted by the use of the following group tests, for each of which is stated the approximate time needed for its administration:

Order	*Test*	*Approximate Minutes Needed*
1	Woody-McCall Mixed Fundamentals I	23
2	Trabue Language Scales B and C	17
3	Thurstone Substitution Test	15
4	Bonser Reasoning Tests, III, V, VI	20
5	Thurstone Punched Holes Test	13
6	Equivalent Proverbs, No. VI	23
	Total	111

If more than 2 hours could be used, add:

7 Whipple Marble Statue (deferred recall)

8 Steacy Drawing Construction, 41-100 (in part)

To facilitate the use of these six tests I have prepared a special arrangement of them in the form of a booklet of 16 pages with all necessary instructions to the pupils and with appropriate spaces for recording

personal and scholastic data and for comparing the results of each pupil with the standards set for gifted pupils in the 5th and 6th grades. One of these booklets is needed for each pupil tested. Complete instructions for the examiner are supplied in a separate booklet.*

Following this use of the group tests we deem it advisable to give the pupils provisionally selected, an individual examination, preferably by the Binet tests—this, both in order to give the examiner an opportunity to get acquainted with each child and also in order to confirm the provisional diagnosis and to obtain data that may be directly compared with the scores for general intelligence that have been already obtained for thousands of school children.

C. AN ILLUSTRATIVE CASE

Let us illustrate our ideas by supposing that a certain city school system has 400 fourth-grade (or fifth-grade) pupils who are taught in 10 classes of 40 each. Let us suppose that it is planned to select from these pupils 20 to form a special class in the fifth (or sixth) grade the coming year. Such a class, being limited to the top 5 per cent., would theoretically comprise pupils with I. Q.'s of 120 or above and would be much more competent, as a class, than the Special Class we formed at Urbana. We would proceed thus:

(1) Call together the teachers of these classes and their principals; explain to them the intent to organize

*These materials will be sold by the Public School Publishing Company, Bloomington, Illinois, and by the C. H. Stoelting Co., dealers in psychological materials, 3047 Carroll Ave., Chicago, Illinois. School officials who desire to have these or other forms of intelligence tests or educational measurements applied to pupils or schools by competent examiners working under my personal direction can usually make arrangements for this service by communicating directly with me at the Division of Applied Psychology, Carnegie Institute of Technology, Pittsburgh, Pa.

the "Special Class" or "Opportunity Class" or "Accelerating Class" or whatever name is officially decided on. Request each teacher, in conference with her principal, to select the 25 per cent. (here 10 pupils per class) that would presumably profit best by inclusion in the new class. Make clear (*a*) that the names of 10 pupils are wanted from each teacher, even though fewer than 10 would presumably profit in the Special Class, (*b*) that the possession of a good degree of 'general intelligence' is more significant than the getting of high marks, so that competence outside the classroom ought to be taken into account, and (*c*) that pupils peculiarly good in special directions must be considered carefully to decide whether their ability in other directions is good enough to warrant their inclusion.

(2) Call these 100 pupils together and give them the six tests just mentioned (Woody-McCall I, Trabue B and C, Thurstone Substitution, Bonser III, V and VI, Thurstone Punched Holes and Equivalent Proverbs VI).

(3) Give an individual examination to the 50 pupils scoring highest in these group tests or, if preferred, to all of those pupils who in three or more of the six tests score better than the lower critical scores specified in the test booklets. For this individual examination we have found useful the Stanford Revision of the Binet-Simon tests and also the analogies test given by the individual method as described in Chapter III.

(4) Let the examiner now arrange the 50 pupils, in the light of these individual tests and of the group tests, *in order of their mental ability* and then select for the room by beginning with No. 1 and considering whether that child's physical health, home conditions or place of residence would in any way prevent him from getting the fullest benefit from the Special Class. Eliminate

those who are frail, who are already suffering from 'forcing' either in or out of school, whose parents object to their joining the class or who live where they cannot reach the Special Room without too lengthy transportation. Continue until 20 are found who answer the requirements.

This illustrative case can be modified to meet the situation. We have assumed that the *ideal* class for gifted children would contain 20 pupils, all of one grade, the top 5 per cent., with I. Q.'s of 120 and up. In practice, very likely nearly as efficient work could be done with a class of 30 or 40 pupils; and again, it would be profitable, if necessary to get sufficient pupils, to select the upper 10 per cent. (I. Q.'s of 115 and up) instead of only the upper 5 per cent., or to place in a single classroom, as we did at Urbana, 15 5th-grade and 15 6th-grade pupils. On this basis, it will be seen that a room such as here described could be profitably established in a school system having 150 pupils to select from in each of these grades.

Chapter IX

CHOICE OF TESTS FOR DIFFERENTIATING ABILITIES WITHIN A GROUP OF GIFTED PUPILS

Are the tests that serve best to select the top 20 per cent. of the school population in the 5th and 6th grades also those that serve best to differentiate between the abilities of the pupils within this 20 per cent.? An affirmative answer cannot be assumed forthwith. Moreover, in this investigation we chance to have applied various tests to the selected group that we did not apply to the general school population, so that our range of possibilities is now widened.

We have tried two different bases for grouping the members of our Special Group for comparison with the various tests; (1) the outcome of the careful individual Binet examination, (2) the teacher's estimated rank order of intelligence (June estimate).

Within our Special Fifth, when grouped by Binet outcomes, the best five pupils have an average I. Q. of 136.7; the middle five of 115.7; the lowest five of 105.5. Examining the averages for the same groups in 34 tests, we find that the tests that yield most nearly the same division as the Binet are the following: the two vocabulary tests, Bonser Reasoning I and II, Winch Composition, Thurstone Flag test and Equivalent Proverbs—a list that bears little resemblance to that serving best to separate the Special from the Control Group.

Second, when the Special Fifth is divided into three sections of five pupils each in accordance with their

intelligence as estimated by their teacher on June 1st, 1917, those of the 34 tests that accord most closely with this division of the pupils are: Thorndike Scale Alpha, Trabue Scales B and C, Winch Composition, the Drawing of the Horse and of the Wagon, the Steacy Drawing Tests and the Thurstone Hand and Thurstone Flag tests.

Third, a similar study gave, for correspondence with the same teacher's estimate of intelligence in the Special Sixth, the following: Woody-McCall I and II, Bonser Reasoning I and II, Scale Alpha, Trabue B, C, J, and K, Whipple Word-Building, Winch Composition, Steacy Drawing 41-100, Thurstone Punched Holes, Equivalent Proverbs.

These results are somewhat conflicting. We should expect them to be, because the task of differentiating within a group of pupils already selected as being all of them superior to their mates in school work, is more difficult, both for the tests and for the teacher, than the task of selecting the group as a whole from the total group, and these sub-groups are so small that a special ability might by chance predominate in one. (We have already commented on the discrepancies between the teacher's rank-orders made in November and June.*) However, we may surmise that certain tests are more effective than others in differentiating within a group of bright children and that among these tests are: Winch Composition, Equivalent Proverbs; Trabue B and C, Bonser Reasoning I and II, Thorndike Scale Alpha and Steacy Drawing 41-100. These six tests practically always separate the *best five* from the remaining ten, both in our Special Fifth and in our Special Sixth.

*Page 82.

The one most valuable test of the six is clearly the Winch Composition test; when compared with the standards for composition for the beginning of the 5th grade, the best five of our Special Fifth pupils average the 81st percentile; the middle five average the 72nd percentile; the poorest five, the 39th percentile. Analogous figures for the Special Sixth pupils are the 97th, 84th and 54th percentiles, respectively. It is a matter of great regret that we have no data for this test from our Control Group. One obvious drawback to the use of the test is the labor that scoring involves.

It is also of interest to note that tests of memory for ideas and of improvement due to practise do not serve to differentiate the pupils within the Special Group; on the contrary, the most effective tests for that purpose are tests of ability to use language effectively, to reason clearly and to comprehend what one reads.

Chapter X

THE ADAPTATION OF METHODS OF TEACHING TO FIT THE NEEDS OF GIFTED CHILDREN

Coordinate with the experimental study of the means of selecting gifted pupils, observations were made upon the reaction of the selected pupils in the classroom. This portion of our investigation was intrusted mainly to Dr. T. S. Henry, now of the instructing staff of the State Normal School, Kalamazoo, Michigan, from whose report we have drawn most of the material for this chapter.

In the various American cities there have been devised flexible promotion schemes (ungraded classes, grade skipping, promotion by subject, quarterly promotions, etc.) that favor to a greater or less extent the school progress of gifted children. The educational public is familiar, for instance, with the 'plans' worked out at St. Louis; Elizabeth, N. J.; Pueblo, Colo.; Cambridge, Mass.; Odebolt and LeMars, Iowa; Portland, Oregon; North Denver; Santa Barbara; Chicago; Newton, Mass.; Woburn, Mass.; Arlington, Mass.; and elsewhere.*

Dr. Henry has studied the systems in vogue in these cities and has gathered information by correspondence with superintendents in numerous other cities where all sorts of variants and combinations of the better-known plans have been evolved to meet the local situation, and it is to be hoped that this material† may sometime be published in full.

*See the school reports of these cities, also the publications of Clerk, Holmes, McDonald, Van Sickle and others, listed in the bibliography at the end of this book.

†A doctor's dissertation for the University of Illinois, 1917, entitled "Classroom Problems in the Education of Gifted Children."

Information has also been gathered concerning the operation of the special classes for gifted pupils that have been established at Baltimore; Indianapolis; Worcester, Mass.; Cincinnati; Harrisburg; Louisville; Boston; New York City; Lead, S. D.; Framingham, Mass.; Lincoln, Ill.; Manchester, England; Charlottenburg, Germany; and elsewhere.*

In the experimental room at Urbana there was practically continuous observation of the work of the selected pupils by one or more of the investigators, and this observation was supplemented by a somewhat elaborate practice experiment in multiplication (see pp. 53-54) to measure the effectiveness of systematic drill, and also by what might be termed 'experimental teaching' by Dr. Henry, himself, who in this way compared the manner in which these pupils received and assimilated a given lesson unit with the response that would be obtained from the usual fifth or sixth-grade class. Dr. Henry,

*It is true that it is quite difficult to ascertain just what cities do maintain special *classes* for gifted children. R. A. F. McDonald published in 1915 a doctor's dissertation from Teachers College, Columbia University, in which is printed a list of *twenty-two* cities that reported "special schools or classes for exceptionally gifted pupils in their public school system." Dr. Henry, at my suggestion, got into direct communication with several of these twenty-two cities and found that one of them only occasionally promoted individual pupils; one had a room for dull but never for bright children; one had a 'mixed' room for both dull and gifted (!); and two gave individual coaching to pupils who were trying for special promotions. It is unfortunate that misleading and inaccurate statements should have crept into such influential publications as the *Teachers College Contributions to Education*. A still more impossible statement is that made by Miss Elizabeth Woods in the March, 1917, issue of *Educational Administration and Supervision*, when she states that *forty-five* cities have classes formed of gifted children only—a statement that I judge can be construed as accurate only if any rapidly moving group in a system where flexible promotion prevails is characterized as a "special class."

I had several years ago the experience of soliciting from the Bureau of Education at Washington a list of cities making special provision for "pupils of exceptional ability." When I discovered that almost every one of the more than sixty cities to which I was referred made provision for subnormal pupils only, and wrote to that effect, to the Bureau, I was somewhat startled to be informed that "pupils of exceptional ability" meant dull and backward pupils otherwise known as abnormal! I suppose by the same construction "men of exceptional wealth" would be found in the almshouses!

This terminological vagueness is only another symptom of the scant attention that has been paid as yet to the needs of the gifted pupils.

Miss Coy and the writer also devoted some time to observing the very successful "Opportunity Class" at Louisville, Ky., and in discussing with the teachers there and in other special rooms for superior children, the means of adapting methods of classroom instruction to the needs of bright children.*

From these sources of observation and information we have assembled a number of conclusions† and recommendations concerning the organization and conduct of special rooms for gifted children.

There are certain ones of these recommendations that apply to any schoolroom but that, nevertheless, take on, in our opinion, an added significance when the room is devoted to the instruction of gifted children. These recommendations will be stated first and then those recommendations that apply more specifically to classes for the gifted.

A. RECOMMENDATIONS, PERTINENT TO ANY CLASSROOM, THAT ASSUME ADDED IMPORTANCE IN CLASSROOMS FOR GIFTED CHILDREN

1. The teacher of a special room for gifted children should possess a large fund of general information.

It would be trite to assert that any teacher would succeed the better for being well informed. Our point is here that a group of gifted children exhibit an unusual range of interests and wealth and variety of mental association; they have points of contact not so often avail-

*In the published accounts of classes for gifted children there is considerable attention to aims, results, methods of organization, and study programs, but there has been little said concerning the pedagogy of these classes. The reader may consult the articles by Flora Unrich, Martha Adler and Rose Patterson (see bibliography) for some positive suggestions on the pedagogical aspects of the problem.

†Most of these conclusions are quoted with some paraphrasing from Dr. Henry's thesis.

able in the instruction of ordinary children and that ought obviously to be capitalized. One of the first things usually said by teachers of these rooms to whom we have talked is: "These children certainly keep me guessing." Or: "I have to use my spare time stocking up on information so as to anticipate a reasonable fraction of their questions."

2. The teacher should have had adequate foundation in the theory and practice of teaching.

Here, again, we state a desideratum of any teacher. But with the gifted pupils the ordinary stock methods will not do. To get really efficient instruction there must be not merely definite plans for work that imply sound professional knowledge, but also ability on the part of the teacher to grasp and to execute adaptations and modifications of method that are suited to the education of gifted children.

3. The teacher should be characterized by energy, enthusiasm and an inspiring personality.

Good traits, these, for any teacher! But it strikes us that they are peculiarly needed by the teacher of gifted children, who have an unusual capacity for work that often needs to be stimulated and inspired if it is to be enlisted in the daily work of the school. One of the main arguments for the segregation of the gifted pupils is precisely this: only by segregation can they be brought to exert themselves to the utmost, to develop habits of industry and by competition and example to learn the rewards of persistent effort. Fully to gain these ends a teacher of unusual energy and stimulating capacity is wanted.

4. The special room should be equipped with movable desks, and should be well supplied with maps, charts, globes, pictures, and other aids to study.

The use of movable desks gives much more freedom of movement to the pupils, and makes possible much greater variety in conducting the exercises of the school. If the pupils have access to books for supplementary reading, to maps, globes, and other illustrative material, their study will be more independent, and they will have better opportunity to learn how to work for themselves.

5. Emphasis should be placed upon the development of the pupils' initiative.

A prominent feature in the education of bright children is the increase of opportunity for the exercise of initiative on their part, with a consequent insistence upon self-reliance and free expression.

6. Much use should be made of the "principle of application."

In carrying out this principle, pupils must be encouraged in all possible ways to make immediate and practical application of what they have learned, in the acquisition of new knowledge and in the other activities of the schoolroom. In particular, the teacher may often very advantageously make use of this principle in provision for review. The opportunities in this direction are greater in classes of gifted pupils.

7. Instruction should be as much as possible by broad, underlying principles, rather than by detached facts.

This is an important principle in all teaching, but it can be realized to a much greater extent with bright children than with ordinary ones, and consequently needs to receive greater emphasis in their instruction.

8. An important feature of the teacher's method is the development of a proper perspective of the material of instruction.

This implies the ability to estimate the relative importance of the different topics and pieces of subject

matter in order to distribute time and energy properly among them and to insure that the more important topics receive the greater attention. We have gained the conviction that this ability to maintain and to develop perspective is more needed in the instruction of gifted children.

B. RECOMMENDATIONS PERTAINING SPECIFICALLY TO CLASSROOMS FOR GIFTED CHILDREN

9. The enrollment of a special room for gifted children should represent ordinarily a selection of approximately the top ten per cent. of the general school population in the grades that are to be represented.

We say "ordinarily ten per cent." because our experiment shows that the upper ten per cent. can accomplish sufficiently more and better work to warrant their segregation. To lower the standard, say to fifteen per cent., would, we are sure, impair the working efficiency of the segregated group and lose most of the objects for which the segregation was made. On the other hand, when administrative conditions permit the raising of the standard, say to five per cent., there would be a decided gain in homogeneity within the group and a decided augmentation in the range, rate and brilliancy of the work accomplished.*

*I have often wondered why some well-endowed private school did not raise its standards of admission to the last notch and convert these standards into those of mental ability. Suppose, for instance, a school that would admit no pupil whose ability was not as good as the "best boy in one hundred," and suppose that no amount of money or 'pull' could place a boy of less ability inside its classrooms. It is easy to predict what would happen. Teaching would become a heavenly delight; the best instructors of youth would clamor for a place on the faculty; within a few years colleges would compete for the product of the school and its reputation would spread far and near as the place where the brainiest young men of the country were produced. Its graduates would excel wherever they went and their superior achievement would be attributed by the unthinking public to some unusual superiority of instruction that could be gained only in that school; applications for admission would increase until the school had a 'waiting list' from which it could pick and choose its student body to suit its needs and purposes. Is there anything chimerical about this plan? And is there anything undemocratic or snobbish in an aristocracy of brains?

10. Sound health should be a prerequisite for admission to classes for gifted children.

One of the commonest stock objections to the thesis that gifted children ought to be segregated for special instruction is that this process will undermine their health and that any sort of forcing is unnatural and injurious. Doubtless those who raise this objection picture a gifted child as a puny, anemic, 'hot-house' affair with an over-developed brain poorly supported by an undernourished body. We have not encountered these freaks among our children. However, there is a type of nervous child who has undoubted ability but whose school work is a perpetual source of worry; who attains his place at the head of the class by overwork and at the sacrifice of physical development. These children are not wanted in classes for the gifted. The ordinary everyday kind of gifted child can pursue the work of the gifted classes serenely, with no undue strain, with persistent effort yet without impairment of health. He feels better if kept at work than if guarded against reasonable exercise of his native intelligence.

11. The method of selecting gifted pupils should be by mental tests, not by teachers' estimates of the pupils' ability nor by school administrators' inferences from school marks.

The demonstration of the truth of this statement has occupied the bulk of this monograph and need not be summarized again here.

12. The teacher in charge of a special room should be carried along with it in its advancement, and should remain with it as long as it retains its organization.

This arrangement makes for economy of time, in that it becomes unnecessary for the pupils, at the begin-

ning of each year, to adjust themselves to the characteristics, methods, and requirements of a new teacher; nor is any time lost by the teacher in making the acquaintance of a new set of pupils. It also permits greater freedom in the organization of subject matter from year to year in the course.*

13. In the special room for gifted children, drill should be decreased by about 50 per cent.

Correspondence with teachers shows this to be a prevalent practice in rooms of this kind, and corroborative evidence has been furnished by the work of our own special room. Results of learning-tests indicate that practice is more efficient in the case of those who already possess high initial ability.†

14. Likewise, explanation should be reduced about 50 per cent. in amount, and needs to be given in much less detail than to ordinary pupils.

This is also the common practice in special rooms for gifted pupils. It is justified by the quickness with which the children learn and by their greater ability in perceiving relationships.

15. The teacher of the special room for bright children need pay but little attention to discipline, beyond seeing to it that the pupils have work enough to keep them busy.

*I would also suggest that the teacher ought to keep quite full notes of the daily work of her class, with critical comments thereon. When she relinquishes her first set of gifted pupils and begins again with a new group, she will then be supplied with valuable material to guide her work. Memoranda of this sort are peculiarly useful in the absence of printed lesson plans and daily programs that will fit the needs of these special classes. They ought to make a contribution worth publication for the aid of others in this work.

†Note, for illustration, the drill experiment in multiplication described in the chapter on educational tests. Note that two weeks' drill brought our Special Fifth, which at the time of the experiment had done about six weeks of the sixth-grade work, up to the level of a class that had been doing the regular sixth-grade work for seven months.

The testimony of those who are engaged in giving instruction to special groups of bright children is practically unanimous to the effect that no disciplinary troubles are encountered. While bright children sometimes cause trouble in ordinary rooms, because of their lack of employment, when they are placed in a room where they have plenty of work to occupy their attention, and where they must exert themselves to keep up with their fellows, their idleness gives place to industry, and they cease to give any trouble on the score of conduct. The only recommendation that needs to be made upon this point, then, is that the teacher see to it that the pupils have work enough to occupy their time.

16. If any of the pupils in the special room seem to be developing egotistic tendencies, the teacher should apply the 'social check.'

Contrary to the impression entertained by some, segregation of superior children does not inevitably develop in them undemocratic ideas and attitudes. Quite the opposite; in fact, there is *more* opportunity for the development of the feeling of superiority on the part of the bright child in the regular room than in the special room. Under ordinary conditions, the bright child stands out conspicuously above his fellows; his superiority is acknowledged by them, often to the point of resentment, and he is keenly aware of it. When a question has gone round the rest of the class without receiving an answer, the teacher turns to him with an air of finality and relief. Such opportunity for display does not come to the child in the special room, for here he is among real competitors, and in place of being always in the lead he must often exert himself to keep up with the rest. Of course, it will not be out of place for a teacher of a special

room, as well as any other teacher, to keep close watch for the beginnings of vanity and egotism in order that she may promptly check them. This can often be done by comparing the work of the child who needs to be thus corrected with that of some other pupils of superior, or at least equal, ability in that particular line. It is actually easier for a teacher to hold such tendencies in check in a room where the pupils are of about equal ability than in a room where the bright children are conspicuous by their superiority over their classmates.

17. Corresponding to the special adaptations of method, there should be a readjustment of emphasis in subject matter.

Modification of methods of instruction must perforce bring about modification in subject matter.* Corresponding to the lessened amount of drill, there will be a lessening in the number of problems and exercises in the formal subjects. Less attention should be given to details of secondary importance, and more emphasis placed upon necessary principles. Much of the purely explanatory matter in the textbooks may be passed over lightly, or even entirely omitted. It was found, in our experimental room, that the children often knew much of the matter ahead of them in the course of study, and this made it possible for that material to be passed over rapidly. Especially did this happen when a new volume in a series of textbooks in the same subject was taken up. For instance, the advanced textbook in geography, which

*Attention may be called in this connection to the reports of the Committee of the Department of Superintendence on the Economy of Time in Education, published in the *Fourteenth Yearbook, Part I, Sixteenth Yearbook, Part I, Seventeenth Yearbook, Part I,* and *Eighteenth Yearbook, Part II, of the National Society for the Study of Education.* These reports ought to be of great assistance by outlining the minimal essentials of subject matter in the elementary school and thus reversely by indicating subject matter that is needlessly taught or taught at the wrong time or by wasteful methods.

the Special Sixth began to study at about the middle of the year, began with a review of the definitions and principles which the pupils had learned in their study of the intermediate book. Since it was found that the children were already perfectly familiar with practically all this material, this portion of the book was used only for a rapid review, instead of being made the subject of definite and extended assignments, as would have been the case if the matter had been entirely new. Exactly the same thing took place in fifth-grade arithmetic and sixth-grade language.

18. The teacher of a special room for gifted children should be allowed wide latitude in modifying the course of study to fit the purpose of the room and the needs of the pupils.

The investigator's work with the experimental room during the year has thoroughly convinced him that a great deal of freedom should be allowed the teacher of a gifted room in following the conventional course of study. All the investigators feel that from the standpoint of the experiment, as a whole, a considerable amount of time has been lost in doing work which could be justified only on the ground of preparation for the somewhat rigid requirements of a conservative school system. The fact that we were not allowed to alter the sequence of any of the branches of subject matter seriously interfered with our efforts to condense the regular course of study for the two years into an economical and efficient one-year course. If a teacher of the type which has been recommended is once secured, she should be left in comparative freedom to select what she considers the essential parts of the course of study, and to present them in the order which is best adapted to the needs of

her class. The time saved by these methods would afford opportunity to add a considerable quantity of outside material of a cultural nature, much of which might well be supplied by the pupils themselves. This added material might include, among many others, such things as extended supplementary reading of standard literature (mainly for appreciation), dramatization, pageantry, free discussion of the important topics in the news of the day, the collection of newspaper clippings correlating with the work in civics and hygiene, the illustration of history and geography with such relics, costumes, utensils, etc., as are available or can be procured, especially those which the pupils are able to bring, enrichment of the work in history by some consideration of industrial history, study of local city and state industries in connection with the work in geography, and so on through a long list. In some cases it might be possible to take up the study of a foreign language, as was done in the "Opportunity Class" at Louisville, where fourth-grade children were given daily lessons in German, wholly by the conversational method.

Special rooms for gifted children are of two general types. One type, which is the more common, contemplates a saving of time by providing for the more rapid progress of the pupils. The other makes no provision for the saving of time, but makes use of a course of study different from the ordinary one in that it either (*a*) contains more of the same kind of material, or (*b*) includes different material, which is usually of a more cultural nature. Of the second type, the latter arrangement is by far the better. It is subject to one danger, however, in that in the attempt to add cultural material the course may be so diluted as to defeat one of the most

important purposes of such rooms, *i. e.*, the provision of opportunity for gifted children to learn what hard mental work is. This danger, however, is not inherent in the scheme and may very easily be avoided.

Although most of the special rooms for gifted children now in operation have a course of study so arranged as to make it possible for the pupils to do three years' work in two, this study has shown that bright children of the fifth and sixth grades can do two years' work in one, and the same gain in time has been accomplished in one or two other rooms of the kind. By lessening the amount of drill, decreasing the amount of explanation, and, on the side of subject matter, omitting or passing rapidly over what is already known or of relative unimportance, enough time can be saved so that all of the essential topics of the two years' work can be mastered in one. There will be time enough left, in addition, to make possible the introduction of a considerable amount of cultural material of the kind mentioned above, by which the course will be enriched and made to connect more completely with the lives of the individual pupils.

Chapter XI

AN ANALYTICAL STUDY OF TALENT IN DRAWING

As explained in the introduction it was felt that the study of the selection and training of gifted children ought to be supplemented by a study of the restricted sort of superiority that we designate as 'talent.' For several reasons talent in drawing, as revealed under school conditions, seemed a promising field for such a study. Dr. H. T. Manuel devoted his time during 1916-17 to this work. His theme was this: what are the psychical traits or psychophysical traits that are significant for superior skill in drawing and how may the presence of these traits be best diagnosed by tests?

A. General Plan

The general method pursued in the study was simply to discover a number of persons (five college students, 8 high-school students and 6 elementary-school pupils) whose work in drawing was conspicuously good, to apply to them a considerable number of tests and also to gather information of a non-experimental character about their abilities, interests and other personal traits. Ideally, we would like complete 'psychograms,' as Stern terms them, of numerous persons endowed with exceptional talent, for at present we have no objective method of determining talent in embryo or even of predicting its development when it makes its initial appearance. It is, as Kerschensteiner remarks "an uncommonly great, but also a very difficult task of experimental pedagogy, to find the key for the appraisement of these different talents."

B. PREVIOUS STUDIES

Like all pioneer studies, this one has proceeded slowly and has in some respects performed its most valuable service by clearing the way for further explorations. An examination of previous studies of drawing* shows only three studies, those by Binet, by Kik and by Kerschensteiner, that are related at all closely to this one.

Binet† conducted a rather extensive investigation of the talent and the mental characteristics of a young painter named Tade Styka.

Kik‡ studied thirteen children who showed conspicuous talent in drawing and arrived at certain conclusions with regard to the nature of special talent, the types of ability in drawing, the influence of heredity and the influence of intelligence, but his data are limited to the non-experimental field.

Kerschensteiner§ collected thousands of drawings from the school children of Munich, rated them and studied the pupils who made the best ones with respect to age, sex, school grade, general school success, parental calling, home training, etc.

C. THE TESTS EMPLOYED

Of the 19 persons studied by Dr. Manuel, eight were selected for extended laboratory tests (12 to 16 hours per capita); six of these were students in the local high schools and two were students in the Department of Art and Design of the University of Illinois. Six elementary

*See, for instance, F. C. Ayer, *The Psychology of Drawing*. Baltimore, 1916.

†A Binet. La psychologie artistique de Tade Styka. *L'Année psychologique*, 15: 1908 (1909), 315-356.

‡G. Kik. Die übernormale Zeichnenbegabung bei Kindern. *Zeits. f. angewandte Psychologie*, 2: 1908, 92-149.

§G. Kerschensteiner. *Die Entwicklung der zeichnerischen Begabung*. Munich, 1905. 508 pp.

school pupils who showed the most skill in drawing among the pupils of the fifth and sixth grades were also tested rather exhaustively in conjunction with the experimental work carried on by Miss Coy with the group of gifted pupils.

The following were all the tests employed in the investigation; not every subject was given all of them. No special stress is placed upon the classification here employed.

List of Tests Used in Studying Talent in Drawing

I. Tests of General Intelligence

1. Stanford Revision of Binet with special reference to
   - a. Memory for digits
   - b. Designs
   - c. Sixty words
   - d. Clock hands
   - e. Vocabulary
   - f. Fables
   - g. Code
   - h. Inclosed boxes
   - i. Paper cutting
   - j. Logical memory

II. Tests of Higher Thought Processes

A. Linguistic Ability; Linguistic Invention

2. Word building (Whipple)
3. Language scales (Trabue)
4. Composition (Winch)

B. Controlled Verbal Association

5. Hard opposites
6. Analogies (Whipple A, B, C)

C. Invention from Graphic Forms

7. Ink blots (Whipple)
8. Pictorial imagination (after Rossolimo)

D. Understanding and Reasoning

9. Easy and Hard Directions (Woodworth and Wells)
10. Equivalent proverbs, I, II, VI.
11. Reasoning (Bonser, I and II)
12. Reasoning (Thurstone)

E. Mental Manipulation of Spatial Forms

13. Hand test (Thurstone)
14. Spatial relations test (Thurstone)
15. Punched holes (Thurstone)
16. Painted cube test (Rugg)

F. Esthetic Judgment

17. Esthetic appreciation (Thorndike)
18. Esthetic judgment (Illinois)

III. Tests of Memory and Learning

A. Logical Memory

19. Marble Statue (Whipple)
20. Dutch Homestead (Whipple)
21. Cicero (Whipple)
22. Lincoln and Pig (Whipple)

B. Memory for Visual Forms

23. Recognition of lineal figures (Rossolimo)
24. Recognition of colored figures (Rossolimo)
25. Recognition of pictures (Rossolimo)

C. Learning

26. Substitution (Thurstone)
27. Perceptual learning (Manuel)
28. Mirror drawing (star test)

D. Imagery

29. Questionary for visual, auditory, kinesthetic (Betts)

IV. Tests of Reading

30. Reading forward (Whipple)
31. Reading backward (Whipple)

V. Tests of Perception and Observation

32. Cancellation (Whipple, 4 forms)
33. Observation test (Rossolimo)
34. Description of stamp (Whipple)
35. Spot patterns (McDougall)

VI. Tests of Sensory Discrimination

36. Color-Blindness (Nagel)
37. Visual space discrimination (Manuel)
38. Discrimination of proportions (Manuel)

VII. General Physical and Motor Abilities

39. Tapping (as in Whipple's Manual)
40. Steadiness (as in Whipple's Manual)
41. Aiming (as in Whipple's Manual)
42. Grip (as in Whipple's Manual)
43. Weight (for children)

VIII. Tests of Handwriting and Drawing

44. Quality of handwriting (Ayres scale)
45. Drawing a horse (memory) and a toy wagon (object)

Most of these tests have been sufficiently described in the preceding chapters. Of the remainder those credited to Whipple will be found in the author's *Manual of Mental and Physical Tests;* those credited to Rossolimo are described in *Klinik f. psychische u. nervöse Krankheiten,* Bd. 6:1911, Heft 3 and 4, also Bd.8: 1914, Heft 2. Betts' questionary is in his doctor's dissertation, Columbia University, 1909, entitled *The Distribution and Functions of Mental Imagery.* The painted cube test is described by H. O. Rugg, *The Experimental Determination of Mental Discipline in School Studies,* Baltimore, 1916; the Thorndike tests of esthetic appreciation in the *Jour. of Educ. Psych.,* 7:1916, 509-522. Tests 18, 27, 37, 38.

In attempting to carry out the program thus outlined there was encountered a difficulty that proved more serious than was apprehended—namely, the difficulty of finding standards of performance in the various tests with which to compare the performance of persons gifted

in drawing. Ideally, the performance of a given individual ought to be located in a well-standardized percentile distribution of persons of like age and sex and of all degrees of talent in drawing. This ideal comparison could be gained with only a few of the tests; in others Dr. Manuel used all available data to construct what might be termed 'approximate' percentile distributions; in others comparison could be made only with the averages or medians reported by other investigators; with yet others nothing could be done more than to compare the performances of different persons all gifted in drawing.

Handicapped by this absence of suitable standards of comparison it was nevertheless possible to assemble the results for each subject in such a way as to construct for him a sort of 'psychological profile,' to borrow the term used by Rossolimo. That is, a table was drawn up, and from it a graph, to indicate for each person in which tests he exceeded, in which he fell short, the median performance of his age-group, and in many cases to show also how much his superiority or inferiority amounted to. These tabular and graphical representations of the psychological traits of each person talented in drawing were then supplemented by a brief account of the personality in question, in so far as facts that seem to bear on the possession of drawing talent could be discovered. The following accounts will serve in illustration:

"Subject S7 is 19 years old. His father is a physician, his mother 'an artist, her father an architect and her mother a natural designer.' His paternal grandfather is 'quite mechanically inclined.' The young man's interest in drawing dates from his very early childhood, at about three or four years. His only training in drawing, aside from the regular instruction of the schools, has been a correspondence course which was only partially completed. This course was given up when he entered the Academy. At the age of 17 he did some drawing for a high-school journal. He is most interested in cartooning or illustrating and says he intends to become a cartoonist. Trouble with his eyes has delayed his school progress. The study of mathematics has given him some difficulty. He is interested in

music and plays a saxophone. The instructor in art at the Academy characterizes him as 'distinctly of the artistic type.' "

"Subject S2 is a high-school junior aged 17 years. He stands about second in drawing ability among the pupils in the Urbana High School, according to the estimate of the supervisor of drawing.

"His father is a mathematician, but has drawn illustrations for books. Practically all his mother's people are architects; indeed, her father is a professor of architecture. His only brother is a student in civil engineering.

"This boy was born in America, of Swiss parentage. He first learned to speak English, but before school age, he began to speak Swiss-German dialect, and upon entering school in Switzerland, took up the study of German in the first grade. Upon returning to the United States about five years ago, he began to speak English.

"His first memory of interest in drawing goes back to map drawing in the Swiss schools. After a time it seemed to him that he did not succeed as well as others in the schools, particularly in water-color drawing, and he rather lost interest in drawing on that account. Even now he does not like water-color drawing. He was still in the grade school when he returned to this country and his interest in drawing revived when he found that he could draw better than pupils in American schools. His training in drawing consists in what he was taught in the grade schools plus one year in the high school which included both free-hand and mechanical work.

"He has done practical work in illustrating, some of which has appeared in the Denver *Post*, and some of which will appear in the high-school annual. He likes decorative drawing, but dislikes mechanical drawing. His training seems to have been too limited as yet for the development of highly specialized interests. He wants to become an artist and would like to go into pure art. On the other hand, for financial reasons he may go into illustrating and commercial work.

"Of other school subjects he likes history, literature (though not the kind taught in school), botany and zoölogy. Mathematics, foreign languages, physics and chemistry he dislikes. His average mark for 20 semester grades, not including drawing, is 82.

"He plays the piano and guitar, but does not sing, is interested in outdoor life and athletics, though he does not take part in school athletics."

In a final attempt to summarize the information revealed by the tests and by personal inquiry concerning each subject, Dr. Manuel prepared the following table. In it the numerical records have been combined and generalized so as to describe each subject as superior (S), poor (P), average (A), or normal (N) in general intelligence, linguistic ability, general motor ability, handwriting, observation, memory for visual forms, etc. The table is continued to reveal the age, the present school grade, the father's occupation, the degree of originality, the time when interest in drawing appeared, the existence of talent in drawing among relatives, the existence of ability in music, and other similar facts. It will be understood that the compilation of this table was attend-

ed with much difficulty and that not all the generalizations can claim scientific reliability; nevertheless, the lay-out of the results in this fashion serves a useful purpose in showing to what extent any given tendency seems characteristic of persons gifted in drawing.

D. SUMMARY OF EXPERIMENTAL AND PERSONAL DATA

Subjects	General Intelligence	Linguistic Ability	General Motor Ability	Handwriting (7)	Flexibility of Motor (8) Habit (Mirror Drawing)	Discrimination of Differences and Proportions (9)	Observation	Memory for Visual Forms	Imagery (Visual, Auditory, and Kinesthetic)	Mental Manipulation of Spatial Forms	Invention from Graphic Forms (8)	Esthetic Judgment	Color Vision	Drawing Tests	Drawing (Estimates of Supervisors and Teachers)
E1	P	PA	AP	S	P	A	SA	PA	—	AP	A	PA	N	S	S
E2	A	A	SP	A	S	S	SA	PA	—	PA	AS	A	N	S	S
E3	P	P	SA	A	P	A	S	SA	—	SA	S	A	N	S	S
E4	S	PA	SAP	P	A	A	SA	AS	—	A	SA	AP	N	A	S
E5	A	PA	A	S	S	A	SP	PA	—	PA	P	A	N	A	S
E6	S	S	SP	S	S	P	A	AP	—	AP	A	A	N	P	S
S1	S	SA	SAP	A	S	PA	A	S	P	S	A	PS	N	SA	S
S2	A	P	SP	P	A	SP	SP	PS	PAA	SP	A	SP	N	A	S
S3	S	S	SAP	A	S	S	A	S	S	S	A	AS	N	SA	S
S4	S	S	SP	P	S	A	SA	AS	SAA	SA	AS	AP	N	S	S
S5	S	S	SP	S	S	A	AS	S	SSA	S	PA	SA	N	SA	S
S6	A	A	AP	S	S	P	AS	S	SSP	SP	AS	A	N	S	S
S7	A	AS	—	—	A	—	—	P(1)	—	—	—	—	—	—	—
S8	A	A	—	—	A	—	—	S(1)	—	—	—	—	—	—	—
C1	S	S	SA	A	S	A	S(4)	S(6)	—	AS	S	AS	P	S	—
C2	S?	—	SA	—	—	—	—	S(5)	SSP	PA	—	S(3)	—	S	—
C3	P	P	—	A	—	—	—	A(5)	—	A	—	P	—	S	—
C4	A	A	A	A	S	SA	SA	AS	A	S	P(2)	A	N	S	S
C5	S	A	S	A	S	AP	PS	LS	SSA	SA	A(2)	A	N	SA	S

(1) Code test only.
(2) Pictorial imagination test only.
(3) Thorndike test only.
(4) Rossolimo test only.
(5) Perceptual learning test only.
(6) Code and Rossolimo tests.
(7) Handwriting rank of elementary pupils based on school grades; high-school students and adults are compared within group only.
(8) Elementary pupils are compared within group only.
(9) Elementary pupils: discrimination of differences only, and compared within group only.

Key to symbols: S, superior; A, average; P, poor; N, normal;—no information.

Subjects	Age (Years and Months	School Grade	Occupation of Father	Original?	Time when Art Interest Began	Was There Period of Relative loss of Interest
E1	13–10	6	Tailor	Less		
E2	11–6	6	Insurance	Yes		
E3	13–1	6	Policeman	Yes		
E4	10–10	5	Horticulturist	Yes		
E5	10–9	5	Blacksmith	Less		
E6	11–8	5	Contractor	Less		
S1	19–8	IV	Farmer	Yes	Always drawn. Special interest sixth grade	
S2	17–2	III	Mathematician	Yes	Early in school	Yes
S3	16–9	III	Physicist	Yes	Very early	No
S4	18–8	IV	Physician	Yes	Very early	
S5	17–6	IV	Pattern-maker	Yes	First day of school	No
S6	18–10	III	Estimator	Yes	Age seven	Yes
S7	19	IV?	Physician		Age three or four	
S8	15–3	I & II	Artist			
C1	Adult	Coll. 4	Lawyer		Early childhood	
C2	Adult	Coll. Grad.				
C3	Adult	Coll. 2	Decorator	No		
C4	Adult	Coll. 4	Farmer	Yes	Early childhood	No
C5	Adult	Coll. 4	Electrical Engineer	Yes	Early childhood	No

Subjects	Drawing Talent Among Relatives	Music: Plays or Sings
E1	Father draws and letters. Brothers and sister good in school drawing.	
E2	Mother artistic. Brother good in school drawing. Two uncles architects.	
E3	Father was best drawer in family, but is untrained.	
E4	Maternal aunt of mother very good in oil painting.	
E5	Cousin is draftsman.	
E6	Mother a former supervisor of art.	
S1	Sister showed special aptitude in high school	
S2	Mother's people architects. Father illustrates.	Yes
S3	Younger brother and sisters draw with promise.	Yes
S4	Brother, special aptitude in school. Maternal uncle and aunt draw as "side interest."	
S5	Uncle draws—talent not developed.	Yes
S6	Father without training but makes sketches.	Yes
S7	Mother artist.	Yes
S8	Father and mother artists.	
C1	Father draws but lacks training. Younger half-brother draws with promise.	Yes
C2	No artists among relatives.	
C3	Father and mother artists.	Yes
C4	Mother has shown ability. Sister draws but lacks training.	Yes
C5	No artists among relatives.	

Read the table as follows: E1 is poor in general intelligence. In linguistic ability the results of the tests are contradictory: in one or more tests her record is poor, and in one or more tests it is average. (Personal data are self-explanatory.)

E. INFERENCES CONCERNING THE PSYCHOPHYSICAL CHARACTERISTICS OF PERSONS TALENTED IN DRAWING

With the experimental results before us, even in this partial way, it is fitting to see what generalizations can be drawn concerning the mental and physical make-up of persons who possess undoubted talent in drawing. Most of the generalizations must be negative ones, but that does not mean that they are not worth the making: in psychological pioneering of this sort it is as important to determine that something is 'not so' as to determine that something else is 'so.' The inferences that seem permissible will be presented, then, in one-two-three order, with a few words of comment where necessary.

1. *The term drawing applies to a very complex process, and the production of an effective drawing calls into operation a number of varied and distinguishable operations.* It is not surprising, then, that analysis* is difficult. There are all sorts of drawing, not one clean-cut variety of endowment.

2. *Correspondingly, persons talented in 'drawing' exhibit marked individual differences in their mental and physical characteristics.*

From these two conclusions follows naturally a third:

*Samples of attempts to analyze the factors in this complex activity may be seen in Albien (*Zeits. f. exp. Pädagogik*, 5:1907, 133ff.; 6:1908, 1ff.), in Meumann (*Vorlesungen z. Einführung in die exp. Pädagogik*. Bd. 3; 1914, 726) and in Ayer (*The Psychology of Drawing*. 1916, pp. 157 ff.).

3. Any statement of the 'essential' characteristics of persons talented in drawing presupposes a statement of the particular type of drawing ability that is exhibited.

4. A certain elementary ability in graphic representation, such as is required for success with elementary-school drawing, may exist more or less independently of general mental ability, or general intelligence. That is, distinct ability in elementary graphic representation may appear in children whose general intelligence is much below the average.

5. But ability (a) to acquire the advanced technique into which conceptual factors enter, or (b) to create original drawings of merit implies the existence of a good degree of general intelligence.

In practice, for example, a pupil of decided skill in drawing whose general intelligence proved mediocre could hardly be encouraged to train himself with the view of becoming a great painter, an architect or an expert cartoonist, but he might do exceedingly well as a sign painter or as a copier of decorative patterns.

6. Linguistic ability, save as it appears indirectly as one index of general mental ability, is not correlated with ability in drawing; i. e., linguistic ability may or may not be associated with ability to draw.

7. The sort of motor ability present in drawing is not revealed by any one of the stock tests of 'motor ability.' Talent for drawing does not presuppose any general, or all-round motor superiority.

The fact is, of course, that 'general motor ability' is itself more or less of a myth. One who stands high in one motor test may stand low in another.

8. Persons who exhibit talent in drawing show no

*uniform tendency to write well; handwriting and drawing are relatively independent performances.**

9. There is some evidence, though unsatisfactory, that the flexibility of motor habit, or ability to form new sensori-motor habits, that is demanded in the mirror-drawing test may be exhibited more decidedly in persons talented in drawing than in persons not talented in drawing.

Eleven of our 17 subjects who took this test are ranked as 'superior,' but unfortunately eight of the eleven are girls and women, and there appears to be a sex difference in this test favorable to their sex.

10. The ability to discriminate fine differences in distances, lengths, curves and proportions, though seemingly one essential to good drawing, is not satisfactorily measured for diagnostic purposes by our Tests 37 and 38 (discrimination of differences and proportions).

11. Despite individual differences, tests of 'observation' (Nos. 32, 33, 34, 35) appear to have some value for the diagnosis of ability in drawing.

The stamp test (No. 34) is of less value than the others because of the introduction of the linguistic factor in making the report. Nearly all the persons talented in drawing made average to superior records in the cancellation tests (No. 32), and only one made a poor score in the Rossolimo test (No. 33). The greatest variety of performance appeared in the spot-pattern test (No. 35).

12. Introspective reports of possibly questionable reliability indicate that while many who are talented in drawing have superior visual imagery, nevertheless good achievement in drawing may coexist with poor visual

*This fact is commented on by Freeman, *The Psychology of the Common Branches*. 1916, p. 34.

imagery. The same thing may be said of kinesthetic imagery.

Logically, it seems as if capacity to visualize well, to command visual imagery, were a prerequisite to skill in drawing, but here as in other aspects of mental life, the readiness with which mental substitution, vicarious mental functioning, may occur is striking. We may cite Binet's statement, in the course of his study of Tade Styka, the young painter: "I shall add also the conclusion that one may be an admirable draughtsman with a very ordinary visual memory." The present writer is reminded of the positive declaration made to him by Pillsbury, the celebrated blind-fold chess player, that he did not ordinarily visualize his games.

13. Memory for visual forms is worth testing (Test 27) for drawing ability, although certain forms of drawing ability may coexist with a low degree of this memory.

14. A similar conclusion may be drawn concerning ability to manipulate spatial forms mentally (Tests 13, 14, 15, 16).

A difficulty that appears in the use of some of these tests ought, however, to be pointed out. Probably achievement in the more difficult of these tests is rather directly conditioned by general intelligence; in others achievement may be partly conditioned by familiarity with the material, *e. g.*, familiarity with geometrical names and objects. However, these tests might still be useful for instructional purposes, as for instance, in determining whether a pupil has the capacity to concentrate his attention upon the sort of material with which he must deal.

15. The two tests used in this study in the attempt to measure inventiveness and imagination in the graphic

field (Nos. 7 and 8; ink-blots and pictorial imagination) are of doubtful value.

16. The two tests of esthetic judgment (Nos. 17 and 18) did not agree with each other in their ratings of our subjects. Skill in drawing may coexist with poor esthetic taste.

F. A DESIRABLE PROGRAM FOR TESTING ABILITY IN DRAWING

The investigation by Dr. Manuel may be thought of as having cleared the way for further approach to the practical problem—the development of relatively simple and reliable tests diagnostic of drawing talent, analogous to the set of tests recommended for the diagnosis of superior general intelligence.

We need such a set of tests because it is not sufficient to measure simply the end product, the drawing. The fact that one child gets on well in drawing in the schools and that another does not, must not be taken forthwith as an indication of the comparative drawing talent of the two children. Interest in drawing may be manifested by children with no inherent manual skill, and these children will often make good progress under school instruction, enough to show an acquired skill sufficient to deceive the teacher on the search for the real superiority of talent.

"Sargent and Miller, in their *How Children Learn to Draw,* p. 235, remark:

"As a matter of fact, the representation of isolated things does not furnish an adequate motive for children except for the few to whom form and color of themselves make an unusually strong appeal and awaken a vivid inner experience. For these few, desirous to express what so strongly impresses them, ordinary nature and object drawing is sufficient, and they make excellent progress in it. These are children with so-called 'special talent.' In most cases this type of talent in elementary schools appears to consist primarily in a special interest and not in a special endowment of skill. This interest is related to skill as cause to effect. In other words,

if we can induce an equal interest on the part of other children, they will develop equal skill. One of the significant facts brought out in the course of the work previously described is that not infrequently children who show under ordinary circumstances no indications of talent will, when the appeal to their particular interests is found, equal or surpass in skill those who appeared at first to be gifted artistically."

Every one recognizes this sort of thing in the field of music; many persons are keenly interested in music and can develop good musical appreciation yet never become artistic musicians or perhaps even moderately good amateur performers.

The present investigation suggests that the materials for such a set of diagnostic tests for drawing talent may be found in the following array:

(1) Tests of the elementary ability to represent, by line and areas, figures and objects directly observed.

(2) Tests of general intelligence.

(3) Tests of ability to discriminate differences in visual magnitudes.

(4) Tests of visual acuity and normality of color vision.

(5) Tests of ability to observe visually.

(6) Tests of memory for visual forms, especially deferred memory.

(7) Tests of ability mentally to manipulate visual forms.

(8) Tests of esthetic judgment.

It seems likely, in the opinion of Dr. Manuel, that Nos. 1, 6 and 7 might advantageously be conducted in the form of what might be termed 'instructed-learning' tests; that is, the test material might be presented in different sections separated by specific instructions concerning the best method of handling the material. Thus, in presenting material for Test I, the first trial might be uninstructed, the next might follow instructions to

proceed in a certain desirable way; the next by another step in method of attack, etc. Such a test would bring most, at least, of the examinees to pursue the same method and would bring to light capacity to take instruction and to profit by it in that particular activity.

To carry out this program the following needs must be met:

(1) Statistical studies of the frequency of specialized ability of given degrees as manifested under present classroom conditions.

(2) A really workable set of scales for measuring achievement in the actual production of drawings under different conditions and of different varieties, *e. g.*, free-hand, mechanical, excellence of composition, excellence of perspective, drawing from the object, drawing from memory, etc.

(3) Sets of standardized tests for measuring the elementary ability to reproduce by lines and areas what is seen, for measuring excellence of esthetic judgment, for measuring memory of visual forms, and for measuring ability to handle visual forms mentally in three-dimensional space. All of these tests should be framed in duplicate equivalent series and applied upon enough pupils to determine reasonably accurate percentile distributions by age and by school grade.

(4) Studies of persons known for their success in various art vocations in order to determine the type of ability which these several vocations demand.

(5) Introspective studies by trained individuals to discover more exactly the relation of imagery to ability in drawing.

G. ANNOTATED BIBLIOGRAPHY OF REFERENCES CONSULTED IN THIS STUDY OF TALENT IN DRAWING

Albien, G. Der Anteil der nachkonstruierenden Tätigkeit des Auges und der Apperception an dem Behalten und der Wiedergabe einfacher Formen. *Zeitschrift für Experimentelle Pädagogik,* Bd. 5: 1907, 133ff; Bd. 6: 1908, 1ff.

Albien's experiment represents an elaborate attempt to isolate experimentally the various parts of the drawing process. Simple figures of varying difficulty were used for copy. Three methods of exposure were used. The first was an exposure for ten seconds by means of the tachistoscope, during which period the eyes remained fixed upon the same point. In the second method, the subject was permitted to view the copy until he thought that he could reproduce it; then he attempted to draw it from memory. In the third method, the figure was drawn with the copy in view. The subjects in the experiments were forty-five pupils, ages 9 to 18, from the *Realschule.* These included children of good, average, and poor ability in drawing and of good and poor intelligence. All except nine pupils had had instruction in free-hand drawing.

Ayer, F. C. *The Psychology of Drawing with Special Reference to Laboratory Teaching.* Baltimore, 1916. Pp. 186.

Contains comprehensive summary of the literature of drawing. Reports also an experimental study of drawing with special reference to laboratory procedure. (1) Four groups of subjects were tested with unfamiliar objects as to their abilities in drawing, description, and diagramming. Correlations were made between the orders of merit of these productions. The groups were (a) 51 high school students, (b) 48 graduate students, (c) 50 college students, and (c) 61 college students. Three of the groups were examined as to their memory of details after they had drawn and described various objects. The second group made introspective analyses of the processes involved, after drawing and describing an object. (2) Grades of 51 high school students were compared with their ranking in drawing as discovered in the special tests. (3) Grades in drawing received by 141 normal school students were compared with the grades received in all other subjects. (4) 16 students were given an experimental test in the effect of analytical seeing upon drawing.

Betts, George H. *The Distribution and Functions of Mental Imagery.* (Doctor's dissertation, Columbia University, 1909.)

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Binet, A. La psychologie artistique de Tade Styka. *L'Année psychologique,* 15: 1908 (1909), 315-356.

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Bonser, F. G. *The Reasoning Ability of Children of the Fourth, Fifth, and Sixth Grades.* New York, Teachers College, 1910. Pp. 133.

Reports an attempt to measure by means of tests the reasoning abilities of children. Factors measured were mathematical judgment, controlled association, selective judgment, and literary interpretation.

Calfee, Marguerite. College freshmen and four general intelligence tests. *J. of Educ. Psych.* 4: 1913, 223-231.

Four general intelligence tests (card sorting, card dealing, alphabet sorting, and mirror drawing) were applied to 103 college freshmen. Correlations were made between the results of the different tests and between the results of each test and the scholastic standing of the students.

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Cubberley, E. P. Editor's Introduction to Freeman's *Experimental Education.*

Introductory discussion of experimental education.

Dallenbach, K. M. The effect of practise upon visual apprehension in school children. *J. of Educ. Psych.*, 5: 1914, 321-334, 387-404.

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Foster, W. S. The effect of practice upon visualizing and upon the reproduction of visual impressions. *J. of Educ. Psych.*, 2: 1911, 11-22.

The material of the experiment consisted of objects, pictures and nonsense drawings. The time of exposure was from 10 to 60 seconds. The drawing was sometimes accompanied by written description. The subjects were three adults.

Freeman, F. N. *Experimental Education.* Boston, 1916. Pp. 220.

A laboratory manual of experiments and typical results in experimental education. Contains introduction by E. P. Cubberley, to which reference is made in this study.

Freeman, F. N. *The Psychology of the Common Branches.* Boston, 1916. Pp. 275.

A textbook in educational psychology as applied to the common branches. Contains a chapter on drawing.

Healey, W. H., and Fernald, Grace M. Tests for practical mental classification. *Psych. Rev. Monog.*, 13: 1911, No. 2.

Describes a number of tests used by the authors in the Chicago Juvenile Psychopathic Institute.

Ivanof, E. Le dessin des écoliers de la suisse romande. *Archives de Psych.*, 8:1908, 97ff.

The author examined critically 9,764 drawings collected from 2,441 pupils in the Swiss schools in an investigation planned by Claparède and Guex. Each child drew (1) from a copy a chair or stool, (2) from memory a cat, (3) to illustrate the fable of *Le Corbeau et le Renard*, and (4) from choice any object. The drawings were accompanied by information as to the age, sex, nationality, rank in general work, subjects for which the most and least aptitudes were shown, etc. The drawings were evaluated according to three standards: correctness of proportions of the drawings, imaginative conception of the drawer, and the technical and artistic value of the drawing. Various correlations between aptitude in drawing and other aptitudes were made. The correlations were made according to age rather than school grade.

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An experimental study of the way in which the perception of simple visual forms is developed. A simple figure composed of straight and curved lines was exposed for ten seconds and the subjects immediately afterward attempted to reproduce it. The figure was exposed repeatedly until the subject was able to reproduce its essential form.

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Rossolimo, G. Berichtigungen und Ergänzungen zur Methodik der Untersuchung der psychologischen Profile. *Klinik für psychische and nervöse Krankheiten,* Bd. 8: 1914, Heft 2.

In these references the author describes a method of testing a number of mental processes. Ten tasks are given in each test. The psychological profile is a graph which represents the number of tasks correctly done in each test, or the mean number done in each group of related tests.

Rugg, H. O. *The Experimental Determination of Mental Discipline in School Studies.* (Descriptive Geometry and Mental Discipline). Thesis, University of Illinois. Baltimore, 1916. Pp. 132.

Summarizes the experimental literature of mental discipline, and reports an experimental study conducted by the author. Of interest in the study of drawing because of the use made of tests requiring mental manipulation of visual forms.

Sargent, W., and Miller, Elizabeth. *How Children Learn to Draw.* Boston, 1916. Pp. 264.

An account in detail of methods of teaching children to draw.

Stern, W. *Die differentielle Psychologie in ihren methodischen Grundlagen.* Leipsig, 1911. S. 503.

A valuable discussion of differential psychology as a new scientific discipline. Methods of acquiring materials, investigating individual differences, and studying individualities are discussed at length. The bibliography contains upwards of 1,500 titles.

Stern, W. The supernormal child. *Journal of Educational Psychology,* 2: 1911, 143-148, 181-190.

Discusses the child of superior ability. Author urges that something be done for the gifted child, and discusses the practical and theoretical problems of the treatment of superior endowment.

Terman, L. M. *The Measurement of Intelligence.* Boston, 1916. Pp. 362.

"An explanation of, and a complete guide for the use of the Stanford revision and extension of the Binet-Simon intelligence scale." Contains bibliography.

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